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Automation & Control

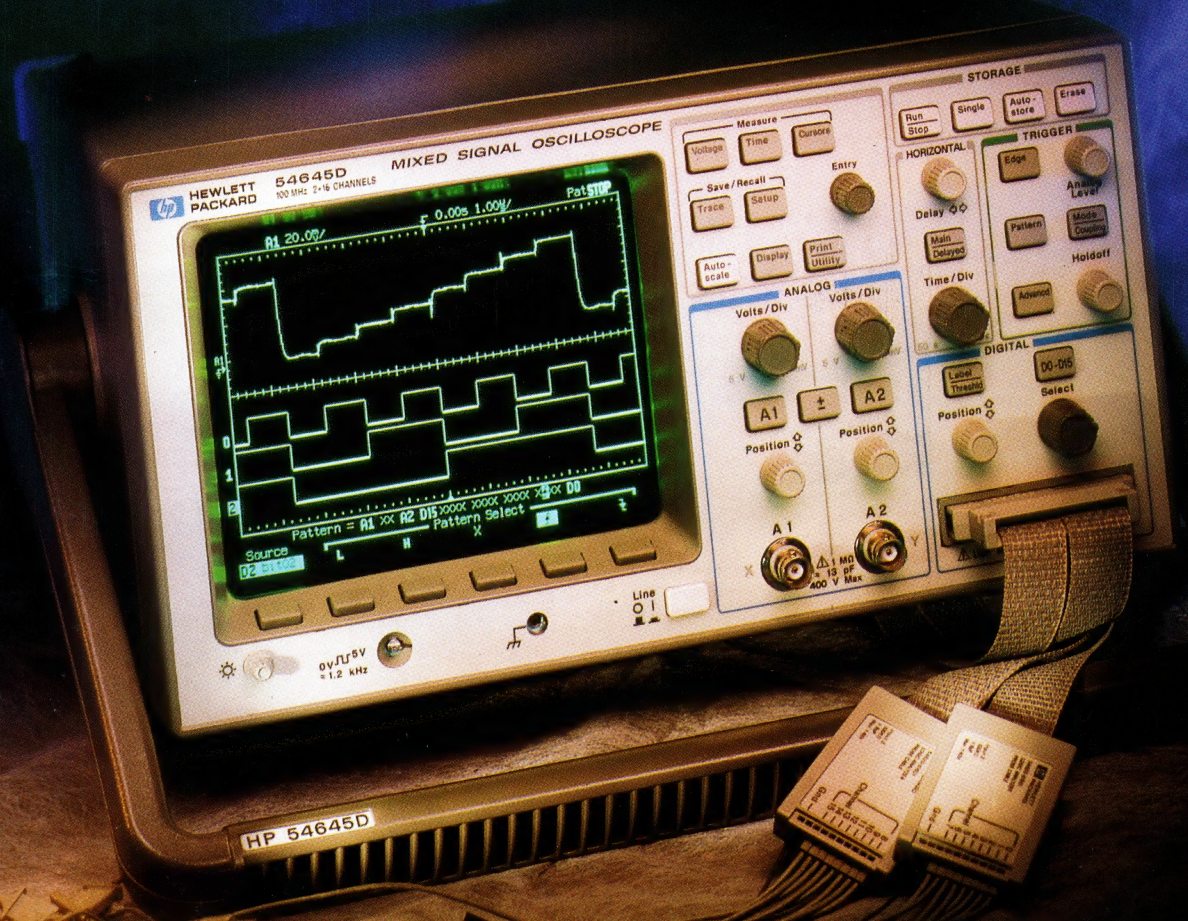
Product Survey — The latest automation & control products
Page 31

The age of the fieldbus
Page 46

Test & Measurement

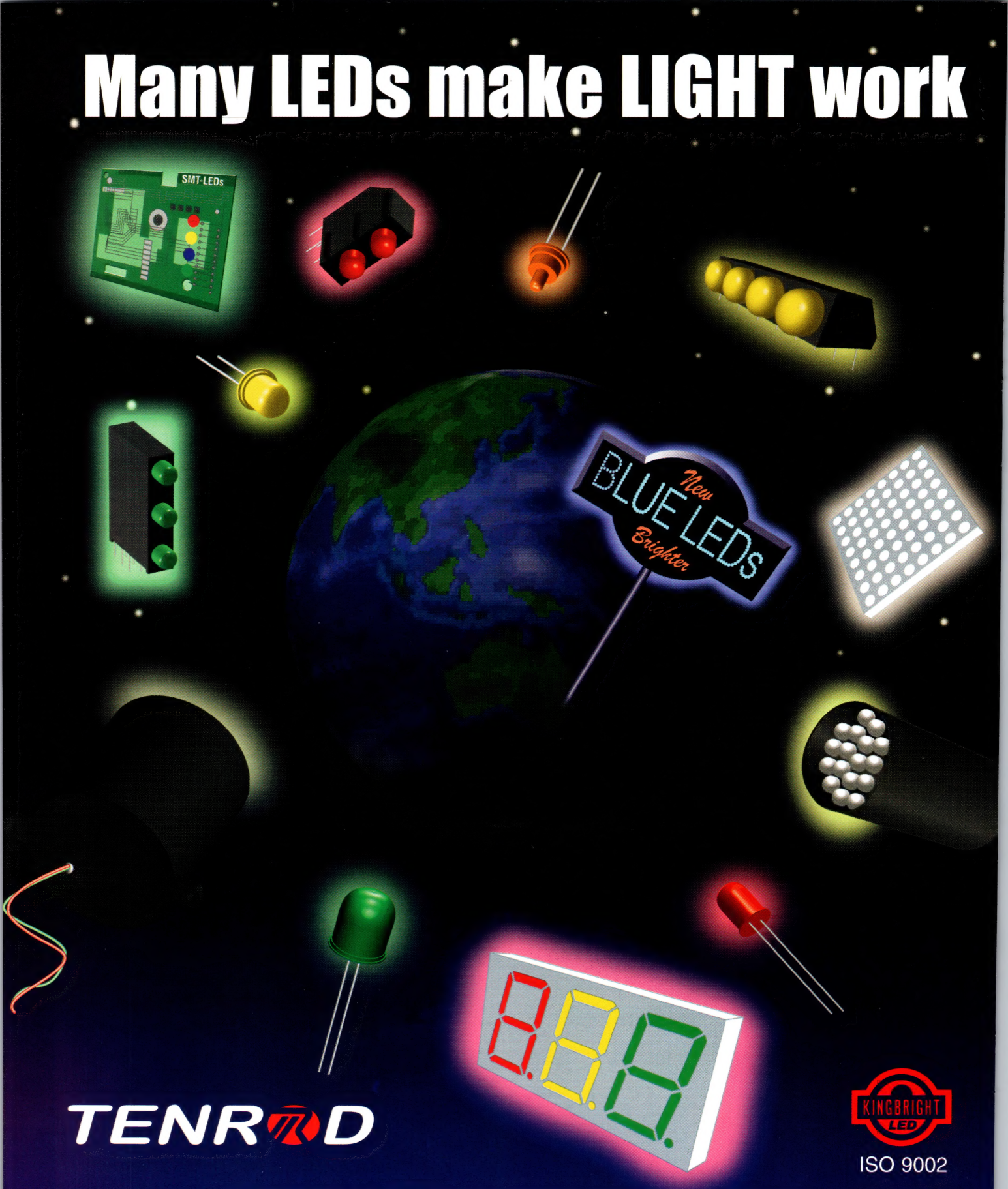
Fundamentals of RF power measurements
Page 52

VXI*plug&play* standards — Redefining VXI products and test system integration
Page 56



Hewlett-Packard's new mixed-signal oscillscope — in a class of its own Page 8

Many LEDs make LIGHT work



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Contents

NEWS

8 Stanilite hits the wall — Telecommunications infrastructure company Stanilite has gone into receivership, the second major Australian telecomms company to fold in as many months.

BUSINESS

26 Virtual companies: The Australian Business Networks Program — AusIndustry is funding Australian companies who join forces to attack export markets as part of a business network.

AUTOMATION & CONTROL

31 Product Survey — The latest products aimed at the automation & control markets.

46 The age of the fieldbus — For years the control industry has been struggling to come up with a cross-vendor digital communications standard for remote instrumentation. The Fieldbus Foundation has finally released a standard it hopes will bring the dawn of the fieldbus age.

TEST & MEASUREMENT

52 Fundamentals of RF power measurement — At lower frequencies, voltage and current are the basic circuit characteristics. At radio frequencies, power is the defining measurement.

56 VXI*plug&play* standards: Redefining VXI product and test system integration — New standards have appeared which attempt to make VXI easier to use as a test instrument platform.

DESIGN TIP #34

72 Filters: Single amplifiers give multi-stage headaches — Some tips on using op-amps in filter designs.

LAST WORD

76 Greg Boundy — Manufacturing a future

DEPARTMENTS

From the Editor's Desk	5
Latelines	7
On The Move	16
In Brief	18
Distributor News	22
Diary	24
New Products	60
Index to Advertisers	62
Literature	70

This month:

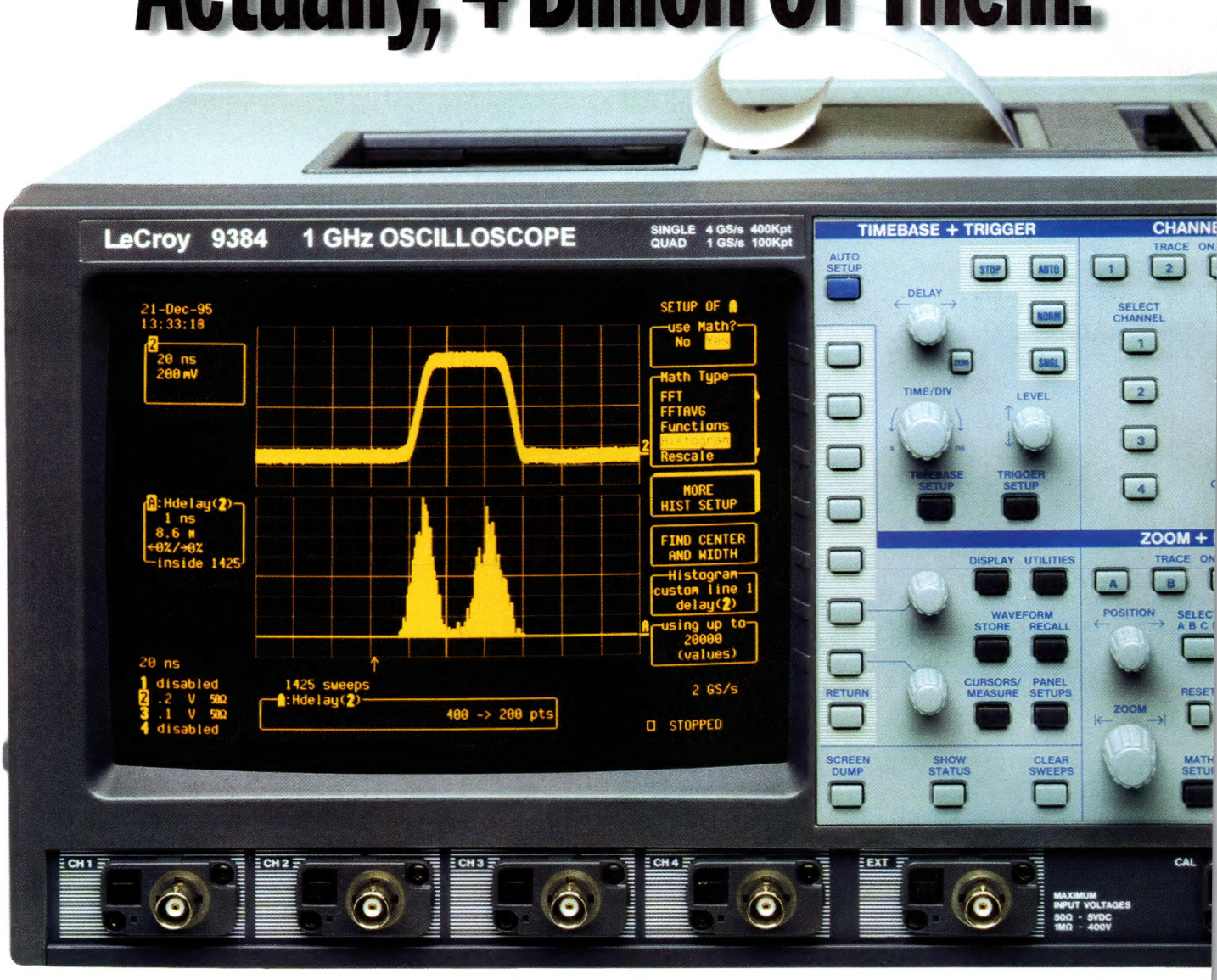
Our product survey this month looks at the latest in automation & control equipment.

See page 31

NEED INFORMATION QUICKLY?

AEE's new Fast Fax enquiry system will help. See page 62

We Want To Drive Home A Point... Actually, 4 Billion Of Them.



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AABP

Another one bites the dust.

Stanilite, one-time model company and showpiece for the government's export initiatives, has gone belly up almost before the gravediggers have had the chance to put poor old Exicom to eternal rest. What's happening to our much lauded telecommunications-led recovery? It's meant to be boom times for companies involved in shuffling various forms of information from one part of the globe to another, so why are they all going bust?

While X-Files' operative Fox Mulder may back a conspiracy theory here, I tend to think that the failures of the two telecommunications giants are unrelated and certainly not part of any general collapse in the Australian electronics industry. However, that doesn't mean we should sit back and adopt a *c'est la vie* attitude. On the contrary, the fact that two such large and seemingly successful Australian operators can turn so spectacularly downward in fortunes should make everyone in the industry pause for thought.

Both companies are good reminders of the fact that no matter how buoyant or booming a sector of an industry is, companies participating in that sector still need to adhere to sound business principles and make good business decisions to survive.

Stanilite has cited problems with two overseas contracts, one in Russia and one in Argentina, as largely responsible for its poor fortunes. If these contracts had such a destructive side to them, why did Stanilite enter into them? Perhaps it failed to adequately research potential problems, or perhaps it just gambled that nothing would go wrong. Either way, it's a reminder that a company just can't afford to get too cocky.

It may be that Australian business is simply not yet mature enough to produce home-grown companies that can perform as stars on the world stage. We have a lot of very successful companies playing in niche markets, but it seems that as soon as a company shoots for mainstream international success, it misses and shoots itself in the foot instead. It's a strange twist on the tall poppy theory, only in this version the tall poppy cuts itself down.

The kindest theory I've heard, and one which I hope turns out to be accurate, is that the Australian electronics industry is simply going through an adjustment phase as it sets itself up to compete in a rapidly-changing global market. Companies like Exicom and Stanilite were too big to adapt quickly enough but not big enough to absorb the impact of these changes. Rather than rein in their resources, as AWA has done recently, they over-extended themselves and suffered the consequences.

The unfortunate thing is that many others in the industry will suffer as a result.❐

Electronics industry shows off

Last month saw the first running of a major new exhibition targeted specifically at the electronics industry. Electronics at Work, put on by the Practical Marketing Group, opened its doors at the State Sports Centre in the Sydney suburb of Homebush on June 5 and 6. The verdict from exhibitors at the show was generally positive — most companies contacted by *AEE* said the quality of leads generated at the exhibition was very good.

AEE editor Rob Irwin (centre) hands out copies of the magazine, a popular drawcard at the exhibition.

David Kyle, managing director of the Practical Marketing Group and show promoter, said he was very pleased with the turn out for the show, both by exhibitors and visitors. "What it boils down to is we got a total of 1642 people through the gate, which I've been told tops what else has been done in electronics shows in recent years," said Kyle. He was also pleased with the quality of visitors. According to Kyle, 40% of those attending were electronics engineers, and some 30% technical managers, directors or consultants. "I must say I'm thrilled, because the general pitch was at engineers themselves and technical management and that's what we got," Kyle commented.

Those companies that had stands at the show seemed to agree with Kyle. Kerrie Hammer from South Australian PCB manufacturer IMP Engineering said she was pleased with level of interest in IMP's stand and the quality of enquiries generated. "I think we got to the right sort of people — engineers and technical managers — and we seem to have done quite well out of it with some good leads," said Hammer.

Barry Hay, national technical manager for R&D Electronics, said he received "quite a few good, solid leads out of the show." Hay commented that while many enquiries came from existing customers, there was a significant number of potential new customers visiting his stand who he feels could "turn into good new business over the next few months."

Adilam Electronics sported a bold new stand design for the show. "There were a lot of comments about our stand," said Adilam's managing director Keith Anderson. "A lot of people noticed it, both customers and competitors, and quite frankly, that was the intention. There've been a few nasty rumours going round about Adilam since the demise of Exicom that are completely unfounded. But people hear them and ask what's going on, so one of the reasons for going away from a shelf scheme to a more noticeable stand was to put those comments to rest."

Anderson was also positive about the exhibition in general. "For an inaugural exhibition I thought it was quite good. I think it got the interest of people, and a few companies wandering around that didn't go in it indicated that they wanted to go in it next time. I think for the first exhibition it was encouraging."

Cate Rejman of Hewlett-Packard agreed. "For a first exhibition, I thought it was excellent. The numbers were a little low, but I guess that might be expected for a first show," said Rejman. "From our perspective it was the opportunity to launch a brand new product — a mixed-signal scope — and that generated a great amount of interest. We got to see a lot of new customers and people we hadn't had a chance to see before."

While Rejman was happy with the show, she did feel that trade shows in general tended not to be as popular as they used to. She said that from an exhibitor's point of view some shows were just "pricing themselves out of the market."

Adilam's new stand design generated a lot of comment.

Mark Breznik from Emona Instruments felt that quality of leads made the show worthwhile. "Often what we find at the larger shows is that you get a large number of enquiries, but they tend to be mostly for smaller items. At this show we had a good proportion of enquiries for things like DSOs and EMC test equipment. You could see there was a good coverage of high level service, production and design-type people going through," said Breznik.

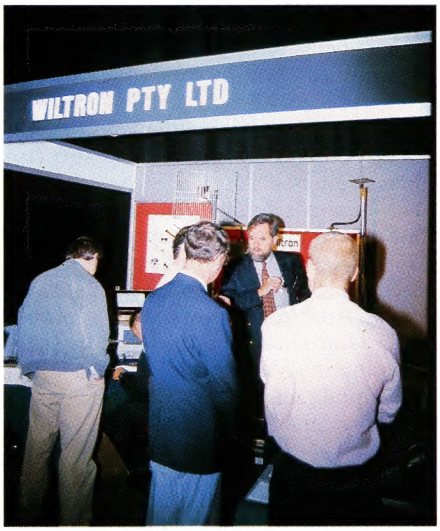
He felt that the workshops and seminars run in parallel with the exhi-

bition made a big difference. "There's got to be considerable value to drag people out to shows these days. I think the workshop and seminar program that was run added good value to this show. Rather than just showing products, giving people the opportunity to learn something added a lot of value," he said.

Running in conjunction with the exhibition was a conference and series of workshops on EMC, as well as seminars on a variety of topics.

Steve Pulver of the Australian Electronics Development Centre (AEDC) which organised the series of workshops devoted to EMC issues, said the turnout was in excess of expectations. "I think we had around 400 people in total across the whole series of workshops, which was better than we were expecting. We were budgeting for about 350, but we thought even that might be a bit optimistic. We were thrilled at the turnout," he said.

David Henry, the NSW manager for Arlec also felt the workshops and seminars played a big role in the success of the show. "We had a continuous stream of visitors at our stand, which I think was influenced by the fact that there was some fairly topical workshops and seminars being run," he said. Henry, however, was "a bit disappointed at the last minute lack of attendance by some major distributors in the industry."



Most exhibitors were pleased level of interest in their products. Brian Thompson of Wiltron fights off the crowds.

Electronics at Work is scheduled to be run in Melbourne next year. David Kyle said that about 65% of this year's exhibitors had already signed up again, and enquiries from new exhibitors were strong. He estimates next year's show will be around 30% larger than this year.❐

The Australian Electrical and Electronic Mnaufacturers' Association (AEEMA) is calling for entries for its third annual **Exporter of the Year awards**. New categories have been created this year to enable more organisations to participate. Members and non-members from Australia's telecommunications and energy/electrical industries can enter the awards, which look at export performance during the past year. The awards are sponsored by the Export Finance and Insurance Corporation and *Australian Electronics Engineering*, *Electrical World* and *Comms Network* magazines, and will be presented in Sydney on September 24 this year. Entries close on August 25. For entry forms or further details contact **AEEMA, tel (06) 247 4655, fax (06) 247 9840** and quote *Australian Electronics Engineering*. ❐

The Sydney Morning Herald reported on June 18 that the Australian Shareholders Association (ASA) has asked the former Stanilite board to explain why the company's difficulties were not presaged to shareholders well ahead of the company going into receivership. The article said the "ASA also pointed to a number of dates leading up to the receivership in which the board commented or published positive remarks on the group's outlook." ❐

The Warren Centre for Advanced Engineering played host last month to the launch of a multilingual Smart Card brochure intended to facilitate the Australian Smart Card industry's development in key East Asian markets. The Deputy Prime Minister Tim Fischer launched the program at the Sydney offices of Keycorp. The function was attended by diplomatic and business representatives from China, Indonesia and Thailand. Mr Fischer told the audience that the production of the brochures, in Indonesian, Thai, Korean and Mandarin, had been made possible by the Market Australia campaign, which concluded on June 30. ❐

National Semiconductor Corporation has reported a lower than expected net income of US$9.1 million, or seven cents per share, for the fourth quarter of the 1996 financial year ending May 26. This is a significant decrease on the same quarter of the previous year, which saw a net income of US$81.2 million for the company. Net sales for the quarter were US$612.4 million, down from US$669.8 million last year. The company said continuing inventory corrections in key segments such as the personal computer market and the distribution channel resulted in lower than expected revenues and decreased factory utilisation. This lower factory loading reduced gross margins and profitability in the third and fourth fiscal quarters. National said it had taken steps during the recent quarter to align costs with current market conditions and expected to see the benefits of these actions during the coming first quarter. ❐

Datacraft Technologies has signed a $5 million contract with US-based Video Lottery Consultants (VLC) for the manufacture of electronic gaming machines. The machines will be used in Melbourne's new Crown Casino when it opens in November. PCB manufacturing for the machines will be done at Datacraft's Mooroolbark facility in Victoria. Assembly and testing will be carried out at Datacraft's Bayswater site. Datacraft will commence delivering the machines to VLC in August and continue throughout September. Since signing a technology transfer and licensing agreement with VLC in November 1993, Datacraft has manufactured over 5000 machines for use in gaming venues throughout Victoria and South Australia. ❐

Industry sources have hinted that giant European component dis-tributor Memec has been negotiating the purchase of the Australian-owned UPL group of companies, which includes local component distributors ACD, ICD and newly-formed company Elektron. Memec, a German-owned company with head offices in the UK, is reputed to be the largest distributor of components in Europe with a turnover in excess of $90 billion a year. ❐

Stanilite hits the wall

One might be forgiven for wondering if something is happening to our telecommunications industry. In the space of two months Exicom and Stanilite Pacific, two of its largest players, have been broadsided (Exicom's downfall was discussed in May issue of AEE.) While some are wondering if the toppling of the two giants is a serious signal to the industry, others see their respective downfalls as unfortunate but unrelated events. Stanilite's nosedive was particularly precipitous, the Australian Financial Review describing it as taking the company "from being a model stock into receivership in the space of a year."

Since winning the AEEMA Exporter of the Year Award in 1995 for the second year running, Stanilite Electronics, the operating name of Stanilite Pacific, has trod a very rocky path. The same contracts (in Russia and Argentina) which helped it win that award were ultimately the cause of its downfall.

The biggest contract won by the company in 1995 was a $37.5 million one to supply cellular phones to Russia. While this was seen as aggressive, pioneering marketing at the time, dealing with the Russians proved difficult and delays in payments cost Stanilite many millions of dollars. Negotiations with the Russian parties resulted in their agreeing to payment on a monthly basis rather than on subscriber uptake but this did not save Stanilite's current situation.

On top of this loss, the company's other big overseas contract supplying Argentina's biggest cellular phone company, CTI, hit the rocks on May 22, with CTI alleging default on the contract and demanding penalty payments. Stanilite's directors held a meeting, at which they decided to appoint a receiver.

All the directors then resigned from the board with the exception of Brian Gatfield, the executive chairman who was appointed in April this year. Brian stepped down a week later.

Arthur Andersen, appointed receivers and managers, will be acting for Stanilite's bankers. Newspaper reports have cited the company owes over $30 million to the National Australia Bank alone, and several more million to leasing companies. A spokesperson for Stanilite said it was hoped the business could be sold in its entirety, and that several expressions of interest of that nature had been received, however the bulk of interest appears to have been in individual business units, mainly defence and lighting which are the most robust. About one third of the 150 expressions of interest received so far have been from overseas companies.

The receivers are expecting a speedy sale and a spokesperson for Arthur Andersen said it expected to move out from Stanilite by the end of July at the latest. Bidders for Stanilite appear serious, with several of the potential buyers already having completed pre-purchase audits (due diligence) to assess its viability.

If the company is sold as a going concern, receivers are hopeful that no or few of the company's 500 employees will lose their jobs. However, *AEE* has been told that up to 10% of Stanilite employees have already been given their final paychecks.

Larger companies known to be suppliers of Stanilite have denied that they have been hard hit by the company's fate, citing extensive debtors' insurance as the reason.

According to a spokesperson for the receivers, Stanilite is continuing to trade through its difficulties and suppliers are being paid as funds are freed. Indeed the receivers told AEE that companies which have steered clear of Stanilite because of fears of slow payment times in the past are supplying the company at the moment.

Stanilite's bumpy road downhill has been visible to the industry for some time, with many people commenting to AEE that the final outcome did not surprise them at all. Rod Tuson of Statronics said the company's demise was no shock, and that any company with such a meteoric growth rate as Stanilite is always more susceptible to things going wrong.

The Australian newspaper reported Brian Gatfield saying in late May that the company's demise was the result of "inadequate management which ignored warning signs". Alex Gosman, executive chairman of the Australian Electrical and Electronic Manufacturers' Association sees its demise as an isolated event, not indicative of any trends within the industry. While this view may be comforting, it would pay those in the industry to take on board the reasons for its collapse.

While the main reasons for Exicom's demise were a series of unprofitable business acquisitions, and disposals, and loss-making non-core activities, Stanilite's end was finally brought about by the collapse of high-risk export deals.

Both Exicom and Stanilite have been accused of overstretching themselves, and perhaps that is where any cautionary tale to the industry might lie. There is no doubt that the telecommunications industry is in boom times and the Australian electronics industry has been riding the coat-tails of this expansion. But the collapse of Stanilite and Exicom is a potent reminder that even in the most buoyant of business climates companies must still adhere to sound business practises or suffer the consequences. ❐

BEHIND THE COVER

Eight-bit, mixed-signal technology is finding its way into everything from toys to space shuttles. **Hewlett-Packard's** new **HP 54645D mixed-signal oscilloscope** meets the needs of mixed-signal designers by seamlessly integrating a two-channel oscilloscope with a 16-channel logic analyser, giving a complete solution in a single, compact, portable instrument.

With its deep memory, real-time display and instant response to controls, the HP 54645D mixed-signal oscilloscope enables engineers to simultaneously and in more detail see what is going on with both analogue and digital circuits.

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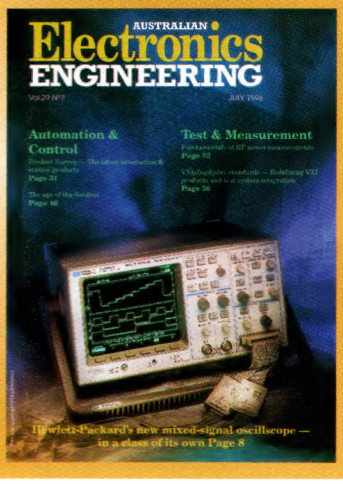

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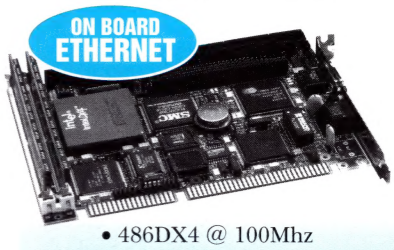

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Siemens beefs up Biloela

Switched on — Siemens' Teleperm XP system at Callide 'A' power station at Biloela.

Siemens must have a happy customer in Queensland's AUSTA Electric. The current refurbishment of the Callide 'A' power station at Biloela includes a contract for Siemens to replace the original Siemens instrumentation and controls installed in the 1960s.

The station, described by a Siemens engineer as a "museum piece", will have the new Siemens Teleperm XP integrated control and monitoring system installed, allowing AUSTA Electric to operate the station remotely. The station is being refurbished to supply power to the state grid.❐

A range of mining cable couplers from MM Cables has been granted a DesignMark from Standards Australia. The Quick Release Restrained Receptacle range is designed for use in the mining industry, providing a more efficient way of connecting and disconnecting the power supply than receptacles fitted with conventional "jacking screw" systems. The DesignMark panel concluded the range contained innovative features, generated time savings, and its use would result in a reduction in labour requirements and potential injuries. The range is being exported to South Africa, Japan, New Zealand and the US. ❐

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EPF10K10	EPF10K20	EPF10K30	EPF10K40	EPF10K50	EPF10K70	EPF10K100
TYPICAL GATES	TYPICAL GATES	TYPICAL GATES	TYPICAL GATES	TYPICAL GATES	TYPICAL GATES	TYPICAL GATES
10,000	20,000	30,000	40,000	50,000	70,000	100,000
USABLE GATES	USABLE GATES	USABLE GATES	USABLE GATES	USABLE GATES	USABLE GATES	USABLE GATES
7,000-31,000	15,000-63,000	22,000-69,000	23,000-93,000	36,000-116,000	46,000-118,000	62,000-158,000

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*Developed through AMPP (Altera Megafunction Partners Program) Note: Individual family members available over the next 12 months.

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HarTec feeling the pinch

Electronics manufacturer and distributor HarTec, former high-tech division of James Hardie, caused some consternation when it released its preliminary statement at the end of May for the 12 months to the end of March. Net profit had nosedived from $4.2 million to $800,000 in the space of a year. Operating profit had dropped 82% to just over $1 million, with operating profit after tax down to $771,000, though for the second half of the year it was actually a loss of $312,000. The loss in the second half of the year was explained by the directors as a "reflection of continued pressure on profit margins stemming from fierce price competition which our customers are up against in international markets and in particular the decline in manufacturing revenue."

The decline in manufacturing revenue was caused mainly by the loss of major contracts with Apple and Digital, leading to the company's contract manufacturing operation incurring a loss for the year. HarTec had had a successful Partnership for Development Agreement with Digital, until Digital took its manufacturing of network systems to the US, a move which Digital assured *AEE* was simply part of its corporate strategy and nothing to do with HarTec's performance. Apple transferred its manufacturing to IBM at Wangaratta. These two losses resulted in a loss of revenue of over $11 million.

The company's distribution operation also suffered through Analog Devices, Belden, Microchip and National Semiconductor engaging extra distributors for their products, distributorships which HarTec used to hold exclusively. The entry of US multinationals Avnet and Arrow into the market also dramatically increased the competition in this area.

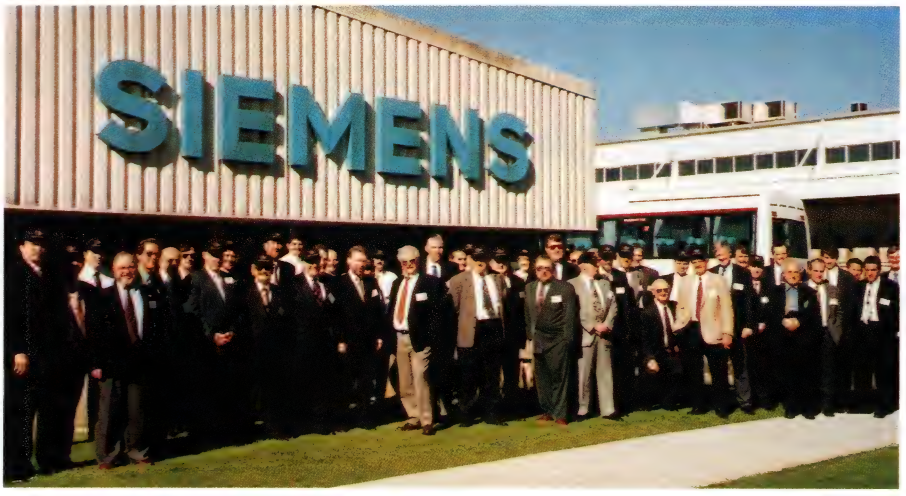
A release from the company said that it was further hampered by the worldwide shortage of electronic components in the first six months of the year. To try to mitigate the effects of this on its customers, the company had increased its stockholding through forward buying. Customers subsequently changed their product mix, leaving HarTec with $800,000 of inventory now uncalled for, of which it has decided to write off half as obsolete. The company's directors said this was followed by deteriorating economic conditions and a slowdown in market growth, and a flattening of demand in the telecomms sector was a further hindrance to their operations.

At the time of writing, HarTec's shares had dropped to 25c, possibly influenced by a gloomy personal commentary column in the Financial Review in the last week of May.

Looking into the future, HarTec's company secretary Mark Preece says the company is not experiencing a cash crisis, has a strong asset backing and has secured some significant contracts — one to assemble PCs for a multinational, as well as distributorships of 3Com products and Hyundai Semiconductors.

Its position as outlined by its directors is to focus squarely on winning new business and controlling costs. It expects a first quarter loss, with a flattening in the second quarter and it expects to pick up in the second half. ❐

Siemens gets chummy



Managers of the 15 largest suppliers to Siemens manufacturing gathered in Melbourne to discuss closer ties.

Siemens is starting a program of fostering its main suppliers to form much more intimate and cooperative relationships for the benefit of both parties. In mid-May it invited its 15 biggest suppliers of components, equipment and services to its manufacturing premises in Melbourne for discussions on working more closely on cross-functional cooperation on R&D, manufacturing, quality and logistics.

Between them, the 15 companies, of whom approximately a third are multinationals, supply around 70% of Siemens' purchasing, about $50 million worth. The remaining 30% is supplied by several hundred minor suppliers. Siemens' manager of corporate purchasing, Artur Muchow, said it was hoped that some of this 30% can be picked up by the new "supplier partners", helping to amalgamate its purchasing base. Geoff Fagan, Siemens' manager corporate communications said "We want to dramatically reduce the money we spend on the 30%"

While this may be productive for Siemens and for the supplier partners involved, it stands to affect a lot of small local suppliers, some of whom could be badly hit.

However for those favoured, things could be looking up mightily — the supplier partners chosen will also be given access to other Siemens manufacturing units around the world, especially in the Asia Pacific and North American regions. ❐

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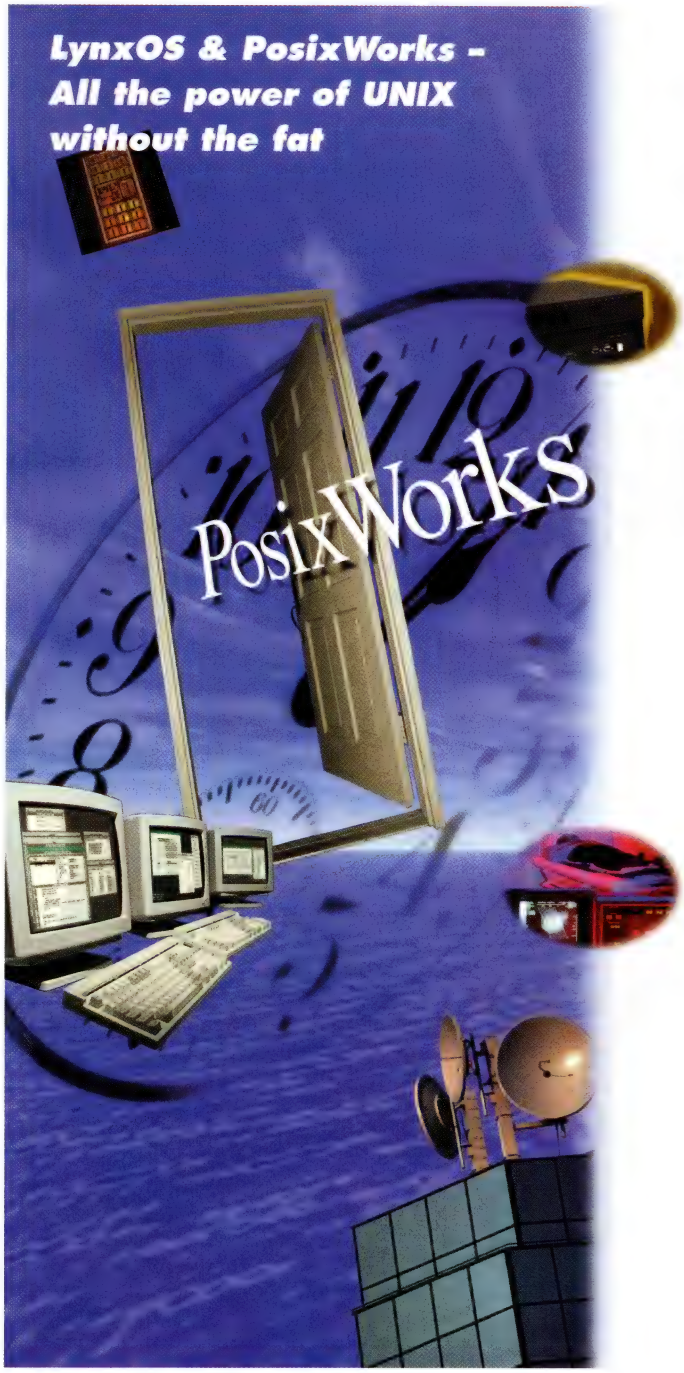
LynxOS puts UNIX on a diet



The move is on to LynxOS. The open standard for deterministic, hard real time response.

While application developers have long been attracted to UNIX for its popularity, applications portability and rich system services, squeezing all that code into real time embedded targets was either impossible or too costly. Moreover, since it was created for work sharing, and not real-time, UNIX's nonpre-emptive kernel, inability to prioritise user tasks, and slow interrupt servicing ensured it could not fully satisfy real-time requirements.

That's where LynxOS comes in. It was designed from the ground up for complex, embedded real-time applications and wherever compliance to industry standards are essential. So now, developers get application portability standards like POSIX and UNIX APIs, with a blazingly fast, pre-emptible kernel, user prioritisable scheduling, and kernel threads for predictable and fast interrupt servicing – all in a compact ROM-able kernel that won't be a memory hog.

LynxOS is ideal for applications where memory is a premium and sophisticated, real-time capability a must. LynxOS can also be scaled up to become a self hosted development workstation complete with networking, windowing and software development tools.

LynxOS also conforms to POSIX 1003.1 and implements all of 1003.b (real-time) and 1003.c (threads) standards.

PosixWorks – The Real-time Integrator

PosixWorks fully integrates industry standard GNU C and C++ language tools, the TotalView debugger and TimeScan performance visualisation and analysis system with LynxOS. It supports systems ranging from compact embedded applications to complex, networked open systems, executing across multiple host platforms including Intel x86, Pentium, Motorola 680X0, PowerPC and SPARC.

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AEEMA export report released

John Almgren, President of AEEMA, with Tim Fischer.

AEEMA's much-awaited report on the export future of Australia's electrical and electronics industry was presented to Tim Fischer, Deputy Prime Minister and Minister for Trade, at the AEEMA board meeting on May 29.

The submission, entitled *Fulfilling the export potential of the Australian Electrical and Electronics Industries* calls for aggressive and focused trade policies from the government, and the removal of high tariffs and non-tariff barriers in many of the major markets which are currently restraining the industry's export growth.

Other export barriers named in the report are standards and testing arrangements, and a lack of recognition in other markets of Australia's capabilities in high-technology manufacturing.

Recommendations in the report to help overcome export barriers include commitments to any further reductions in tariffs being dependent on overall tariffs in APEC being reduced to levels similar to those in Australia; commitments to reduced tariffs having the effect of bringing tariffs among developing countries to levels more consistent with those in Australia; trade facilitation efforts in such areas as standards/conformance arrangements, etc, being based on those markets offering greatest export potential; and the establishment of a Ministerial Advisory Committee on Market Promotion and the retention of the position of "roving trade ambassador".

The report is available free to AEEMA members, and at a cost of $200 to non-members. ❐

Cable modems on the march

The Intel Communications Product Centre team currently servicing the Korean trial, from left: Marcelo Ramirez, Akmal Hamawi, Teri Lasley, Ivan Ho and Rajendra Gupta.

Intel's Communications Products Centre's team is trialling a new internet browsing product which allows you to browse up to three times faster than is possible using existing 28.8Kbps modems. The trial of the "Homenet" service, being run in Korea in conjunction with Korean PC company TriGem, enables high speed information transfer through the cable TV network that is already installed in homes and offices, using a cable modem connected to a PC.

The test service is to begin in Seoul and will then be expanded to cover all the areas that have cable network. A technical training and support service will be provided throughout the trial from Australia and within Korea. The test service is also being tested in the US and Europe.

Intel's intention of putting cable modems in the marketplace as soon as possible is clear, with trials of its CablePort technology to be run in Sydney as well by the end of the year. ❐

Detailed instructions for getting started in VXI:

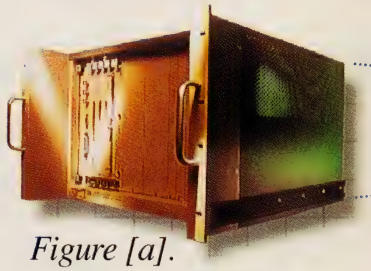

Figure [a]. Our VXI subsystem

Figure [b]. Your rack.

Insert figure *[a]* into figure *[b]*.

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Keith Orchison has been reappointed as the executive director of the Electricity Suppliers Association. Mr Orchison, 53, began his career as a journalist in southern Africa, before emigrating to Australia twenty-six years ago. He has worked in public affairs and issues management and served as executive director of the Australian Petroleum Exploration Association Limited for eleven years. ❐

Lynda O'Grady's appointment as general manager of Business Systems at Alcatel precedes the deregulation of the industry next year, something Ms O'Grady is well prepared for. Her career spans some 20 years in strategic planning, market development and management with, among others, Elders IXL and her own consultancy firm Advanced Management. She holds an Honours Degree in Commerce from the University of Queensland and is a member of the NSW Information Industries Advisory Board. ❐

Lynda O'Grady.

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Defining the future of smart cards

The Cards Australia conference coming up in Sydney on August 20-22 promises to be a watershed for the burgeoning smart card industry in Australia. With projections of 500 million smart cards in use in the Asia Pacific region by the turn of the century, Australia is strategically placed to be a major part of this phenomenon. Currently, multiple trials of various forms of smart cards are either completed or under way, and Australia now boasts a smart card manufacturing facility, one of only eight in the world.

The conference will be covering not only discussions on the technology involved, but a broad range of issues critical to the technology's successful marketing and integration into the marketplace, such as consumer loyalty programs, cobranding of cards, security, privacy, Olympics marketing opportunities, healthcare applications, and reviews of trials currently operating.

Slated to speak are industry heavies such as Hilton Sack, executive vice president, Australasia of Visa International, John Wood, managing director of Keycorp, Beth Horowitz, vice present of chip card business at Mastercard International, Colin Simpson, managing director of Quicklink, and Gary Zentilomo, general manager of Card Technologies Australia.

To register or obtain further information, contact **Erika Morton** at **AIC Conferences** on **(02) 210 5700** and quote *Australian Electronics Engineering*. ❐

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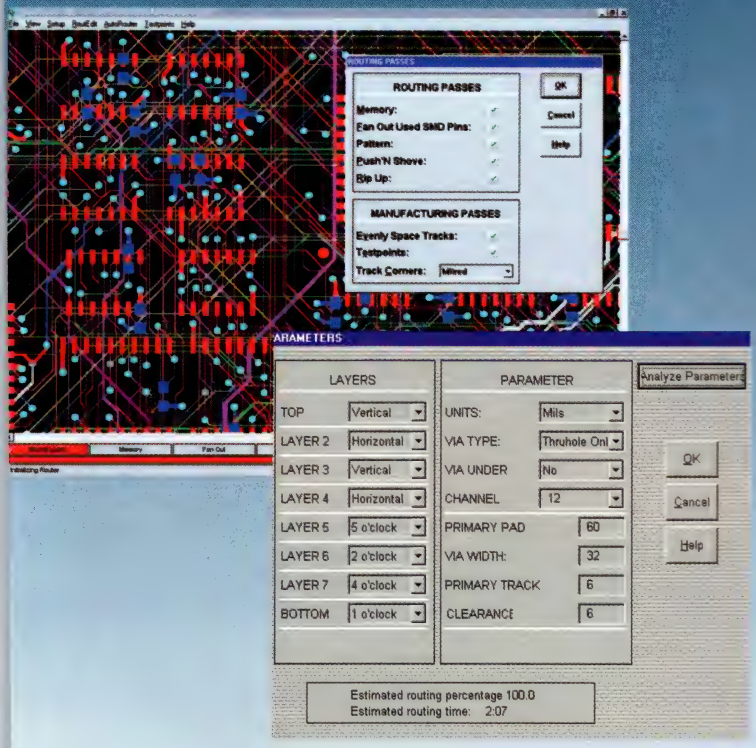

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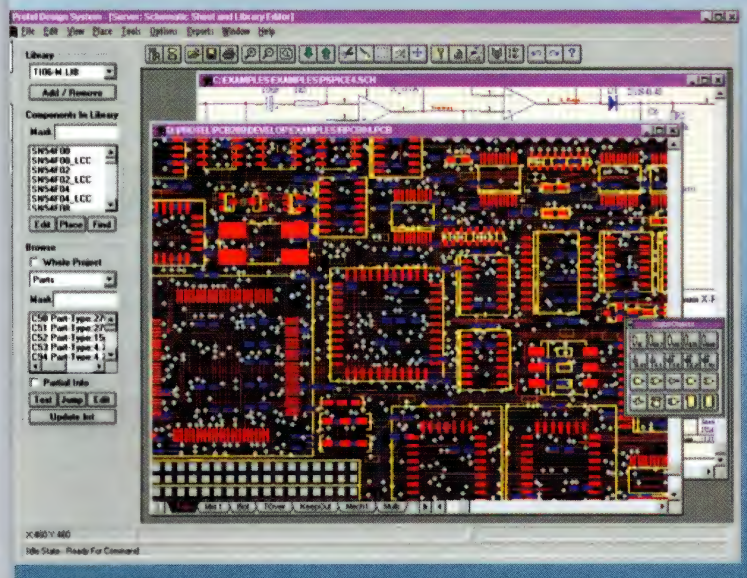

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The Surface Mount & Circuit Board Association (SMCBA) has announced its new executive committee: Tony Losapio, Lyn Dayman, Warren Geering, Edward Hale, Joe Hernandez, Chris Jarvis, Hugh Kelly, Vianney Shiel, Bob Stack and Laurie Thomas. Hugh Kelly is President and Vice Presidents are Warren Geering for the north, and Lyn Dayman for the south. Bob Stack will be executive officer and secretary. Joe Hernandez will be treasurer. ❐

The Australian Electrical & Electronic Manufacturers' Association (AEEMA) has undertaken an in-depth analysis of the impact on its members of the government's possible cuts or changes to industry support programs such as the 150% tax concession for R&D, the EMDG export support scheme, the computer bounty and the DIFF scheme. AEEMA warns that to remove successful industry support schemes prematurely will badly affect industry competitiveness by restricting the critical areas of export and R&D. The worst-case scenario predicted by the study would see a reduction in exports of $300 million, a fall in employment of 4,000 and increased business costs of $180 million. Reductions in R&D could total $100 million. ❐

Philips Traffic & Engineering Systems is about to launch a new electronic toll collection system which allows non-stop cashless toll collection at highway speeds. Vehicles are fitted with an electronic tag which is read as the vehicle passes a toll collection point. The owner's account is debited, either on the tag if it has credit, or through a central revenue management system. The user can be billed on a monthly basis. The technology can be used for either open road non-stop tolling or within an existing toll booth system. ❐

EMC Technologies' Melbourne and Sydney labs have increased the scope of their NATA testing with two addi-tional accreditations. AS/NZS 1044:1995 includes domestic appliances, electric tools and motor-driven devices, and AS/NZS 4251.1:1994 covers products to be used in residential, commercial and light industry applications. The Spectrum Management Agency will accept EMC Technologies' NATA-endorsed reports as proof of compliance with the EMC Framework, mandatory from January 1, 1997, and the same report can often be used to declare compliance with the European EMC directive. ❐

Intelligent Systems has set up a World Wide Web site, accessible at http://www.intelsys.com.au. The site fea-tures extensive technical information on the company's wide range of industrial computers, monitors, keyboards, I/O cards etc. ❐

Hughes Aircraft Company from the US has signed an agreement with Philips Electronics granting Philips rights to sell and lease technology and products from Hughes Transportation and Management Systems. The partnership will provide Philips with exclusive territorial rights to Hughes' intelligent transportation systems products, including vehicle roadside communications, and traffic management. ❐

Telstra claims to have set a world record by completing a 5,000 kilometre synchronous digital hierarchy opti-cal fibre superhighway system. The Perth to Brisbane link enables communications to travel across six states and territories. Telstra says it is the longest 2.5Gbit/s SDH transmission link in the world. ❐

Indonesian telecomms operator PT Telkom has awarded major contracts to two Australian-based companies involving the design, manufacture, installation and maintenance of radio telephone systems throughout Indonesia. NEC Australia's contract is worth $43 million, and Philips' is worth $64 million. ❐

Telecomms consultancy Consultel Australia has completed the design of a new $20 million telecomms net-work for Thailand's second largest retail bank, the Thai Farmers' Bank. The project is expected to offer opportunities to a number of Australian telecomms equipment providers. ❐

Solar power at $1 per watt

Mr David Hogg, managing director of Pacific Solar.

Pacific Solar, a company set up to commercialise Australia solar cell technology, attracted great interest recently at the 25th US Solar Cell Specialist Conference held in Washington in mid-May.

David Hogg, managing director of the company, said "We are pleased to see that several aspects of the developments we have made in solar power are ahead of the rest of the world. We are more confident than ever that we can develop the technology for producing solar cells at just $1 per watt by the year 2000. This will enable solar electricity to be produced at a cost that is competitive with conventional electricity generation, when the eyes of the world will be on Australia as its largest city, Sydney, hosts the 'green' Olympics. Our progress created great interest at the conference at which representatives from 25 countries presented papers."

According to Hogg, what sets apart Pacific Solar's technology is that it is targeting the mass grid-connected market with solar power competing with current low cost methods of electricity generation, rather than the traditional targets of remote areas where other alternatives are too expensive. ❐

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Local security firm upgrades SMT facilities

The Mydata TP11 UPF recently installed at EDM's Sydney surface-mount facility.

Electronic Design & Manufacture (EDM), a Sydney-based firm involved in the production of equipment and systems for the security industry, has recently upgraded its surface-mount capability with the acquisition of a new-generation TP11 UFP pick-and-place machine from Swedish manufacturer Mydata. The new machine is the first step in a planned expansion of manufacturing capacity required by the company's increasing use of surface-mount technology in its products.

According to John Irving, EDM's production manager, the new Mydata robot, which joins an older Juki machine purchased about 18 months ago, essentially triples the company's production capacity for surface mount.

Hugo Waibel, sales engineer with Electronic Development Sales (EDS), the company representing Mydata in Australia, told *AEE* that this was an important sale for the company as it represented the first installation in the country of one of Mydata's latest generation machines.

EDM purchased the machine after seeing it at last year's Elenex exhibition. "Our R&D manager first saw the machine at the Elenex show last year," said Irving. "Because EDS didn't have anywhere to store it, they were accepting requests by interested parties to evaluate the machine."

Initially the machine went from Elenex to modem manufacturer NetComm for evaluation, and then on to EDM. After using the machine at its premises for several months, the company decided to go ahead with the purchase. "We were taking advantage of the offer from EDS by having the machine here and learning something about it," Irving commented. "That was probably the best marketing tool they could have used, because you learn to live with the thing, you learn how to run it and you become familiar with it. It becomes something that you want to have."

Irving said he was attracted to the machine because of its versatility, a feature necessary for EDM's production requirements. "It basically had the capacity to house all of the components for all of our production jobs on the machine at the same time. We can therefore change from one product to a totally different product in probably 30 seconds," said Irving.

EDM plans further expansions with the purchase of a new reflow oven in the near future. "Right at the moment we're limited for space, but we do intend to expand out our west wall," said Irving. "We've actually purchased an additional reflow oven, and when we have that we'll be able to put both systems [the Mydata and the Juki] in line. At the moment they're both sharing the same oven, which limits our capacity to a certain extent."

According to Irving, the expansion of the surface-mount facilities at EDM has been necessary because of a change in design philosophy. "Once we appreciated the production benefits of surface mount, and with the worldwide trend towards surface-mount components, we have been redesigning many of our products to take advantage of surface mount. So apart from our own growth in the marketplace, which includes new export markets, we've created increasing demand for surface mount internally."

Waibel said that after last years success, EDS was looking forward to selling more of the machines at this year's Elenex exhibition. He is disappointed however that this year's show will clash with Singapore trade show Globaltronics. Waibel worries that some potential customers will attend the larger Singapore exhibition in preference to Elenex. ❐

PCB industry structure to change

The global market for PCBs using new technologies such as laser drilling, plasma etching and photo-imageable materials is set to rise from $100 million to $1 billion annually by the year 2000, according to electronics industry consultants BPA Technology and Management.

Highly capital intensive, the new PCB fabrication technologies aimed at meeting the demand for increased interconnection density are expected to have a heavy impact on mainstream multilayer board producers.

The new technologies are now being used in full-scale board production by OEMs particularly in Japan. The BPA study indicates that the new technologies will have significant impact on the structure of the global PCB manufacturing industry. The technologies particularly target the $4.8 billion 5-layer-plus market. When the new processes are made available under licence to merchant board producers, the cost of implementation will limit take-up to the larger companies.

Increased company amalgamations are expected, leading to a global PCB industry made up of fewer, but bigger companies, a trend which is being seen in many other industries. ❐

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Avnet VSI has been appointed as a distributor for **National Semiconductor** in Australia and New Zealand. The company will be distributing National Semiconductor's telecommunications, video and personal systems technology throughout the south Pacific and South East Asia regions. ❐

(left to right)Selwyn Pellet, Avnet VSI New Zealand, John Bevilacqua, National Semiconductor's Australian managing director and Avnet VSI's Robert Crabbe.

TestQuip 2000 has been appointed the Australian agent for **Zwick Material Testing Equipment**, manufacturers of equipment to test the hardness of rubber and plastic, pendulum impact, rebound resilience and rotary bend fatigue and other test requirements. TestQuip are contactable at:**52 Grevillea Crescent, Hoopers Crossing VIC 3029, tel (03) 9748 8547, fax (03) 9748 8086** ❐

Anitech has been chosen to distribute American company **LaserMaster**'s range of large format color printing products in Australia. Under the new distributor arrangement, Anitech will be the sole agent for the new LaserMaster DisplayMaker Express 54" inkjet printer. Anitech's address is: **2/52 Railway Parade Lidcombe, NSW 2141 tel (02) 749 1244** ❐

Polar Electronic Industries, manufacturers of communications accessories and equipment has been appointed Australia and New Zealand distributor by **Kabelwerk Eupen AG**, European manufacturer of telecommunication and power cables. Polar Electronic are located at **2 Commercial Road, Highett VIC 3190, tel (03) 9555 2500, fax (03) 9555 1515.** ❐

Emona Instruments has been appointed distributor of **Algodue Elettronica** power measurement products in Australia. Algodue is a leading Italian manufacturer of power meters, power quality anaylsers, energy management analysers and software. ❐

IRH Components have been appointed Australian/New Zealand distributors by the recently merged **Fujitsu Takamisawa Limited**. IRH Components have already implemented a stocking programme for Takamisawa customers and will provide product support for the Fujitsu Takamisawa range of relays, keyboards, switches and thermal printers. IRH Components can be contacted at: **1-5 Carter Street, Silverwater NSW 2128, tel (02) 364 1766, fax (02) 648 3505.** ❐

Ron Lay (left) of Fujitsu Takamisawa and Ken Bible, IRH's product manager.

New PCB standards guides

Standards Australia has set up a committee to produce two reference guides to the application of standards pertaining to the manufacture of PCBs, printed board assemblies and associated electromechanical components. Part one will be targeted at PCB manufacturers, and part two at PCB assemblers. The reference guides are intended to enable PCB manufacturers to apply a consistent approach in the use of the available standards in Australia. The guides will direct the user to the appropriate standard, addressing issues of usage and future developments and they will provide guidance on variations and inconsistencies between the different sets of standards.

Of the standards used in Australia, the IEC Standards are generally recognised as being the most appropriate for the connector and component fields, and the IPC standards for printed boards and board connectors.

The guides will list all the standards in these fields published by the IEC, the IPC and Standards Australia which are endorsed as suitable for use in the Australian environment. Information on each standard will include a synopsis, the standard's relationship to other standards, its adoption in Australia including its replacement of current Australian standards, progress in revisions of drafts and a section to aid the user in its application.

The guides will also include an overview of the IEC printed circuit publication plan and the IEC classification code for printed boards and printed board assemblies (the Treutler classification system) which is being adopted by both the IEC and the IPC.

Mike Johns, project manager on the committee, said due to the rapidly changing nature of the industry, an important aspect of the guides will be to incorporate feedback from industry. The aim is to include all the practical information that is continually being developed by industry in the daily application of standards.

The reference guides will be put out in draft form for public comment in the next three months, and when the guides are published in final form, a pro forma response sheet will be included to aid the gathering of further feedback from the industry. ❐

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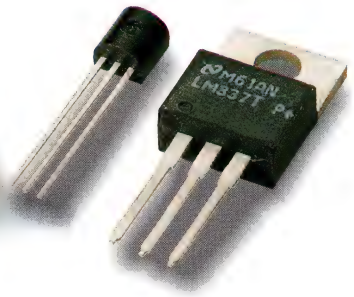

ANALOGUE
Data Acquisition, Amplifiers, Comparators, Regulators, Switching Regulators, Low Drop-out Regulators, Audio, Automotive

RF
Wireless PLL DECT Chipset

DISCRETES
Mosfets, Diodes, Bipolar Transistors

DATA TRANSMISSION
Interface, High Speed Transmission

DIGITAL LOGIC
Metal Gate, HC/VHC, Low Voltage

MEMORY
EEproms, Eproms

MICROCONTROLLERS
COP8

LAN
Ethernet, FDDI, ATM

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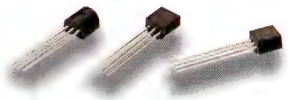

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AUSTRALIA

1996 Australian Software Engineering Conference (ASWEC 96), *July 14–18,* Melbourne. Contact: Prof. Paul Bailes, Dept of Computer Science, University of Queensland QLD 4072, tel (07) 3365 3168, fax (07) 3365 1999. ❐

Locating and Managing Utilities' Infrastructure *July 15*, University of Sydney. Contact: The Electrical Engineering Foundation, (02) 351 3659, fax (02) 552 4920. ❐

Electronic Circuit Board Design *July 15–18 and September 30 – October 3*, RMIT Melbourne. Contact: Gary Kakos (03) 9287 9223, fax (03) 9347 3671. ❐

Growing the high-tech enterprise — Changing approaches to Quality Management *July 24,* Australian Technology Park, Redfern, Sydney. Contact: The Warren Centre for Advanced Engineering, Rm 203, Level 2, Engineering Faculty building J13, University of Sydney NSW 2006, tel (02) 351 3752. ❐

Utilities beyond 2000 *July 29-31,* Hyatt Regency, Sydney. Contact: Interact International Events (02) 9948 6977. ❐

ICEX '96 Instrumentation and Control Exhibition, *July 30–August 1,* Melbourne. Contact: IICA, tel (03) 9816 3333, fax (03) 9857 5057. ❐

The Australian Conference on Exporting (ACE) '96, *July 31 – August 2*, Burswood Resort, Perth, WA. Contact: ACE (WA) Ltd, tel (09) 322 1292❐

Workshop on Data Communications for Engineers and Technicians, *Darwin Aug. 1-2, Brisbane Aug. 5-6, Newcastle Aug. 12-13, Melbourne Aug. 15-16, Hobart Aug. 19-20, Adelaide Aug. 22-23, Perth Aug. 26-27,*. Contact: Kelly Leeson, IDC, P.O. Box 1750 North Sydney NSW 2060, tel (02) 9955 2706, fax (02) 9955 4468. ❐

IT Solutions for Utilities *August 14–15*, Hyatt Regency, Sydney. Contact: IIR Conferences, (02) 9954 5844, fax (02) 9959 4684. ❐

Cards Australia '96 *August 20–22,* Sydney. Contact: AIC Exhibitions, tel (02) 210 5700, fax (02) 223 8216. ❐

Growing the high-tech enterprise — Manufacturing Strategy for high-tech enterprises *August 28,* Australian Technology Park, Redfern, Sydney. Contact: The Warren Centre for Advanced Engineering, Rm 203, Level 2, Engineering Faculty building J13, University of Sydney NSW 2006, tel (02) 351 3752. ❐

PC 96 *September 3–6,* Melbourne. Contact: Australian Exhibition Services, tel (03) 9867 4500, fax (03) 9867 7981. ❐

Elenex '96/SM '96 *October 8–11,* Melbourne. Contact: Australian Exhibition Services, tel (03) 9867 4500, fax (03) 9867 7981. ❐

Growing the high-tech enterprise — Encouraging entrepreneurs: how to build on their ability, *October 16,* Australian Technology Park, Redfern, Sydney. Contact: The Warren Centre for Advanced Engineering, Rm 203, Level 2, Engineering Faculty building J13, University of Sydney NSW 2006, tel (02) 351 3752. ❐

The Home Computer Show, *November 15–18,* Melbourne. Contact: Australian Exhibition Services, tel (03) 9867 4500, fax (03) 9867 7981. ❐

Networld+Interop 96, *November 25–29,* Sydney. Contact: Synergy Conventions, tel (02) 369 1242, fax (02)387 5482. ❐

ACOFT '96, *December 1–4*, Conrad Jupiters, Gold Coast, Queensland. Contact: Conference Secretary, ACOFT '96, IREE Society, P.O. Box 495, Milsons Point NSW 2061 tel (02) 9929 0099, fax (02) 9929 0587. ❐

Visual Basic '96 *December 2–4*, Melbourne. Contact: GUI Computing (03) 9818 6344, fax (03) 9818 7155. ❐

Catching the Tide: Engineering Opportunities on the Indian Ocean Rim, *May 1-2, 1997*, Sheraton Hotel, Perth. Contact: Helena Spedding, Institution of Engineers, WA (09) 321 3340. ❐

SMPTE '97, *July 1–4, 1997*, Darling Harbour, Sydney. Contact: Expertise Events, P.O. Box 547, Manly NSW 2095, tel (02)9977 0888, fax (02) 9977 0336. ❐

OVERSEAS

Australia Taiwan Forum '96 *September 4–6*, Taipei and Kaohsiung, Taiwan. Contact: Conferences Australia tel (02) 9650 6655, fax (02) 9650 3535. ❐

Surface Mount International: Advanced Electronics Manufacturing Technologies, *September 8–12,* San Jose, California, USA. Contact: Yolanda King, Miller Freeman Inc, tel +1 415 905 4994. ❐

Interfinish 96, 14th Interfinish Congress, *September 10–12,* Birmingham, UK. Contact: Interfinish 96 Secretary, IMF, Exeter House, 48 Holloway Head, Birmingham, B1 1NQ, UK. Tel +41 121 666 7190, fax +44 121 666 6316. ❐

Systems '96, 15th International Trade Fair for Information Technology and Telecommunications *October 21–25*, Munich. Contact: Tel +49 89 5107 461, fax + 49 89 5107 180. ❐

Wescon '96 International Electronics Conference & Exhibition/ IC Expo '96 *October 22–24*, Anaheim Convention Center, CA, USA. Contact: Wescon, 8110 Airport Blvd, Los Angeles CA 90045 tel +1 800 877 2668, fax +1 310 641 5117. ❐

19th Convention of Electrical and Electronics Engineers in Israel *November 5–6*, Jerusalem, Israel. Contact: ISAS International Seminars, P.O. Box 574, Jerusalem 91004 Israel, tel +972 2 652 0574, fax +972 2 652 0558. ❐

Electronica 96, *November 12–15*, Munich Trade Fair Centre, Germany. Contact: Margaret Lamy, German-Australian Chamber of Industry and Commerce, Level 2 St Andrew's House, 464 Kent St Sydney NSW 2000 tel (02) 261 4475. ❐

Lithium-ion Battery Design '96: Performance, Safety, Cost *December 9–11*, Hyatt Islandia Hotel, California USA. Contact: Melanie Briggs, Intertech Conferences, 411 US Route One, Portland, Maine 04105 USA, tel +1 207 781 9800, fax +1 207 781 2150. ❐

The 1997 Pan Pacific Microelectronics Symposium *January 29–31*, Sheraton Maui Resort, Hawaii. Contact: Yanic Freedman tel +1 415 964 5111. ❐

The DSP World Spring Design Conference *May, 1997*, Washington DC, USA. Contact: Denise Chan, Miller Freeman Inc., tel +1 415 278 5231. ❐

Asia Telecom '97 *June 9–14*, World Trade Centre, Singapore. Contact: Tom Dahl-Hansen tel +41 22 730 5298, fax +41 22 730 6444. ❐

Telecom Interactive 97, *September 8–14, 1997*, Palexpo, Geneva, Switzerland. Contact: Tom Dahl-Hansen, tel +41 22 730 5298, fax +44 22 730 6444. ❐

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The Australian Business Networks Program.

With help from AusIndustry, many small and medium businesses have discovered the advantages of cooperation when it comes to attacking overseas markets. *Jason Walker* takes a look at the Australian Business Networks Program.

For small businesses in Australia, it's often a daunting prospect to compete on the world stage. With slim resources to hand, successfully marketing your product or service against those of the giant multinationals can be seem a 'David and Goliath' task. But like the proverbial David, a little ingenuity in using the available tools can get you a long way.

One tool which companies are increasingly using, including many small electronics firms, is the idea of networking — companies joining forces to attack a common market. The idea of pulling together for collective good can seem a little strange in a business context, especially when the companies in the network may be traditional competitors on the local front. The idea is gaining momentum, however, and it is estimated that within five years, internationally competitive companies will either be in a network or will find themselves competing against one.

Basically the idea is for companies to combine resources and share the risks associated with launching products overseas. Many overseas companies are unwilling to deal with small Australian concerns. A network however has sufficient size and clout to be treated seriously, a scenario which has been seen many times by AustIndustry. The companies in the network can also share experiences and expertise and put forward complete solutions for overseas contracts, leveraging the abilities of all companies in the network.

Getting into the network

In April 1995 AusIndustry launched its *Business Networks Program*. To assist companies in forming networks, the program offers up to $108,000 to establish business networks of at least three companies which are involved in internationally traded goods or services. The funds help with the setting up of the network, the formation of a business plan, and running the network during the first year of operation.

Most companies that get involved with AusIndustry fall into the category of small-to-medium-sized enterprises (SMEs) and generally have a turnover of between $3 million and $15 million per year. A broker attached to AusIndustry is appointed to each network and monitors the operation of the network and liaises with banks and other institutions as well as ironing out problems between network members.

As well as help with exporting, networking offers solutions to the problems faced by small companies with restructuring or even a lack of access to technology. Marketing, research and development, and capital for expansion are some of the resources available through networking.

According to AusIndustry's Business Network case studies, the key to working within a network is "to use the combined manufacturing strength of Australian participants, marketing products under a single cross-range brand to achieve sustainable competitive advantage."

Following is a look at what's happening on the networking front throughout Australia.

South Australia

Des Masters, State Manager for AusIndustry Business Networks Program in Adelaide is an enthusiastic advocate for small business and industry networks in his state. In particular, he feels the progress SA companies are making in overseas and domestic markets is a source of great optimism.

"What we're doing is putting groups of people together and creating virtual companies," said Masters

He sees the electronics market as one of the most exciting and fast moving of all the industry groups he is currently involved with. There are companies like PRO NET which are producing and marketing control systems for measuring water flow. Also, Vision Systems, currently working with the American Economics Group from Silicon Valley, are developing defence systems for overseas and domestic markets, which is exciting."

A leading business network in South Australia is the Scientific and Industrial Electronics Network (SIEN). SIEN's business development manager, Lewis Steer, is optimistic about developing markets overseas. "One of our companies, Quest Electronic Development, which specialises in point of sale equipment, has developed a computer keyboard with four extra sets of keys which use a sequenced code which can be used with Protel, the computer program for designing schematic and printed circuit boards," said Steer. "Quest have supplied the United States government with them as well

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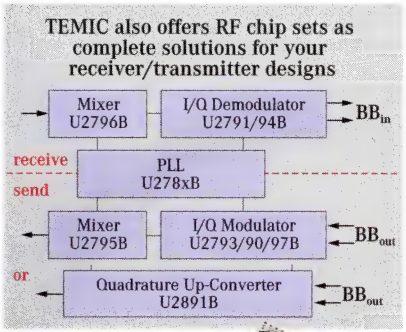

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as Fairfax and the Age in Melbourne, who use them in conjunction with the QuarkExpress program."

Systems Design Services (SA), also under the umbrella of SIEN, developed the Time and Attendance Key, which utilises work-station-based keyswipes to log individual employee attendance records straight onto the computer payroll system. This system has been sold to Mitsubishi in Japan and to companies in Sri Lanka.

Victoria

In Victoria, Baltel is a network of six telecommunications and related research and development companies, and one of seven electronics industry groups in the Victorian program. Baltel has been successful in promoting Victorian telecommunications expertise overseas, winning major contracts for the companies involved.

Another network formed independently of AusIndustry, the Mornington Peninsula Business Council in Melbourne, has been extremely successful with its coalition of local SMEs called Southnet, funded by the Department of Employment, Education and Training (DEET). Southnet runs seminars on exporting as well as other issues of interest to SMEs and regularly holds exporting forums where representatives of Austrade, EFIC and banks are invited out to Southnet's offices for local businesses to consult free of charge. Southnet has even started its own trade missions — it recently organised one to New Zealand with seven local companies. The companies signed deals in NZ worth a total of over $3 million. The group has also had enquiries from Russian and Indonesian business associations who are interested in using the group as a model.

Tasmania and Western Australia

Although there are currently no electronics-related AusIndustry networks in Tasmania, business networking in Australia owes much to the model provided by Techno Park in Hobart, which was founded in 1988. Though not a business network under AusIndustry, Hobart's Techno Park is a collective of companies that supply each other with backup research and other help.

Malcolm Gregory, Techno Park's manager, describes the venture as "a business incubator. The companies interact, share information and generally help each other out. There's a great synergy here."

Gregory went on to say that "the firms based here aren't just electronics centred. There is also a home for software and telecommunications. The thrust of the joint ventures that take place are export oriented, to the point that forty-four countries across the globe are targeted and reached."

Moonraker Australia, manufacturers of long-range tunable antennae for the Australian Navy, Zelcon Technic, responsible for the specialised data loggers used by the CSIRO to track wildlife, and Protel Technology, designers of software for the design of printed circuit boards and schematic diagrams, are just some of the businesses which have been operating at Techno Park since its inception. Gregory describes the combined power of these companies as "export and world competitive." The concepts used at Techno Park in Hobart have since been used in similar sites in other cities throughout Australia.

Western Australia currently has no dedicated electronics/ITT networks at present, but Stuart Knott, WA state manager for AusIndustry, is hopeful of growth there.

New South Wales and the ACT

Barrie Wright is the NSW and ACT state manager for AusIndustry and a man suitably encouraged by what he sees as a boom time for the electronics industry.

He sees his job as identifying markets opening up for electronics and telecomms domestically and internationally, and setting up networks from pools of companies which then develop their own share of that market.

There are currently five networks in NSW and the ACT specialising in electronics and telecommunications. One such group is the Ambulance Network for Asia who are manufacturing communication systems for emergency response groups in Australia and Asia.

The Communications Cluster of Australia (CCA) is another network only recently started, but already experiencing growth. Network broker Tony Jarratt commented that "CCA is providing customised products, systems and consulting expertise in every area of telecommunications and electronic commerce. Indications from informal networking in the past suggest that CCA can produce growth for each of its members beyond the individual companies' capabilities."

Queensland

Oz Electronics are part of the Brisbane Electronics Network, one of the first networks started under the auspices of AusIndustry in 1993. Max Rose, Oz Electronics' managing director, feels that companies must network to survive economic uncertainty.

Rose is full of praise for AusIndustry, which he describes as having provided a focus for network members both corporately and individually. Oz Electronics itself manufactures printed circuit boards and, thanks to its involvement in networking, was able to invest in pick-and-place robots to increase its manufacturing output.

As has been pointed out earlier in this article, there are psychological hurdles to be overcome with business networks. According to Rose, "The multinationals have had to band together over the last fifty years. It's like Holden and Ford, everything they make here doesn't necessarily get sold here. I mean, Holden engines can be found in Hyundai cars. In the electronics game, because the products tend to be innovative and at the leading edge, the designers have the mentality that 'If I don't make this product myself, I'll lose control of it."

Regardless of the sketicism of some, the electronics industry in Australia can greatly benefit from the concept of business networking. It is widely recognised that for an electronics company to prosper in this country in today's market, it must set it's sights wider than just the local game. Business networks provide a useful framework and tool for Australian companies trying to gain a competitive international edge. ❐

The author is a freelance journalist based in Sydney.

AusIndustry — who to contact

Contact the following for information on the AusIndustry Business Networks Program in your State.

- NSW & ACT: Barry Wright, tel (02) 228 4411.
- SA and the NT: Des Masters, tel (08) 300 1500.
- Queensland: Robert Bowen, tel (07) 3224 7651.
- Victoria: Les Leckie, tel (03) 9651 9312.
- WA: Stuart Knott, tel (09) 327 5694.
- Tasmania: Kim Newstead, tel (002) 335 725.

You can also call the AusIndustry hotline on 13 28 460 from anywhere in Australia.

AUSTRALIAN
Electronics ENGINEERING

SPECIAL FEATURE

Automation & Control

Honeywell to introduce instruments and system incorporating FOUNDATION Fieldbus

Page 36

PRODUCT SURVEY

Automation & Control

This month's product survey presents the latest in automation & control. For more information on any item, complete the Enter Card on pages 26 & 62 of this issue.

Version 4.0 upgrades of LabVIEW and LabWindows

National Instruments has announced major upgrades of the company's LabVIEW graphical programming software and LabWindows/CVI visual development software for virtual instrumentation. Established as two leading instrumentation software packages, LabVIEW and LabWindows/CVI can now be used together to build virtual instruments, combining the best of graphical and C programming within a single system. In addition to working together, both products add new productivity, connectivity, and customisation tools to extend them further into the many vertical markets they serve. Both LabVIEW 4.0 and LabWindows/CVI 4.0 introduce tools designed for higher productivity for end-users, system integrators, and corporate developers.

LabVIEW 4.0 features the new FlexVIEW customisable development environment with which users can create their own workspace to match their industry, experience level, and development habits. In addition, LabVIEW 4.0 adds high-power editing and debugging tools for building advanced instrumentation systems. To integrate LabVIEW graphical programs with external software environments, LabVIEW Version 4.0 features OLE-based connectivity and distributed execution tools.

LabWindows/CVI 4.0 extends the complete collection of LabWindows/CVI user interface tools, instrument drivers, analysis routines, and I/O libraries to users of standard C/C++ development tools from Microsoft, Borland, Symantec, and WATCOM. Additionally, LabWindows/CVI adds new SmartCode visual development tools to streamline C code development. Both LabVIEW and LabWindows/CVI are now shipped with CodeLink — a new connectivity tool for integrating standard C code developed in LabWindows/CVI into the LabVIEW graphical programming environment. In addition to existing platforms, both products now feature native 32-bit versions for Windows 95 and Windows NT. [384](9180)

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The Workmate HYLAS PC111T is a flat screen PC workstation with integral infra-red touchscreen, available from Automation & Process Control. The touchscreen-sensitive area extends beyond the screen, providing an area for 'touchkeys'. The user can configure these like a keyboard. The touchscreen driver software automatically converts the touch to the appropriate keystrokes. Users can insert their own legends on or behind the glass screen.

The Workmate HYLAS is fitted with a flat 10.4" colour TFT LCD display. It comes with a single board processor with PC104 expansion slots, or a three-slot passive backplane for half length ISA cards. The unit is fully sealed (IP65) and rated to 50°C. [387](6484)

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Sensors for industrial control

Nucleus Computer Services has introduced sensor modules for industrial card-user applications. These sensor modules are suitable as input devices to industrial control and digital input interface cards from Decision Computer and other manufacturers.

Many types of digital switch sensors are available including a photoelectric sensor, proximity switch sensor, and a mark sensor.

The manual provided includes a data sheet describing the product, a guide on how to connect the sensors, and complete technical specifications on data conversion products. [795](2093)

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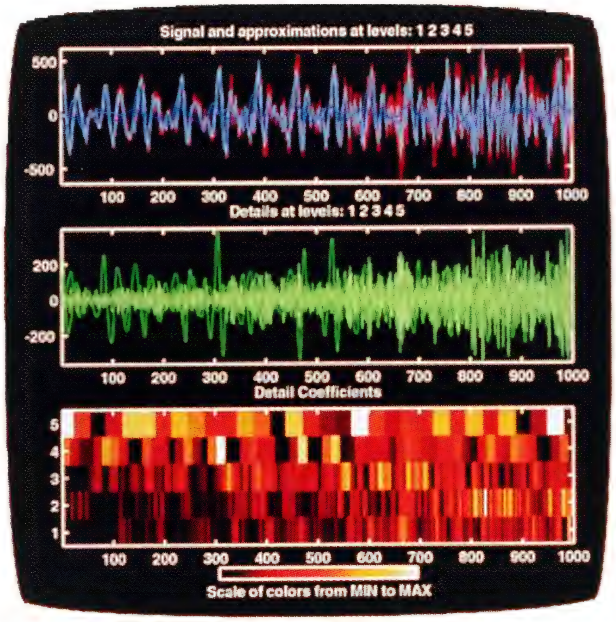

This image from the MATLAB Wavelet Toolbox shows a five-level decomposition of a voice signal. Wavelet analysis is producing breakthroughs in the development of communications signal processing algorithms. Data courtesy of U. S. Robotics Mobile Communications Corp.

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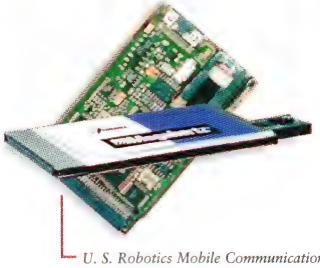

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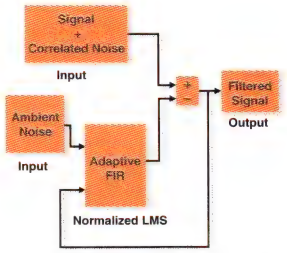

This SIMULINK block diagram shows the use of adaptive filtering to improve signal quality.

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Low-cost CO_2 meter

Vaisala has released a robust and lightweight carbon dioxide (CO_2) meter. It is suitable for spot or safety measurements in a variety of environments, including working and living spaces, greenhouses, mushroom farms, laboratories, process industries, breweries and wineries. The GM11 meter is available in two versions: the GM 11A has a measurement range of 0...3000ppm CO_2 and the GM 11B 0...3% CO_2.

The GM11A operation is controlled via a membrane keypad, with a clear 4 digit LCD provided to display the measured gas concentration. Both audible and visible alarming capabilities are included in the meter; the alarms turn on when the measured gas concentration exceeds the alarm level preset by the user. The meters' housing is IP 65 classified. They come in a rugged weatherproof carrying case, which includes a battery, battery charger and other accessories. The rechargeable battery gives an effective operating time of 12 hours and is easy to change. A simple key function allows the user to check remaining battery life.

The new meters are based on a high performance single wavelength CO_2 sensor which is based on non-dispersive (NDIR) gas sensing. This technique makes the sensor highly gas specific; it is not sensitive to other gases including water vapour, nor is its performance affected by high concentrations of CO_2. The sensor is accurate and it has excellent long-term stability. [1270](4238)

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5V temperature switch

TelCom Semiconductor has introduced the TC622 programmable solid-state temperature switch, available from R&D Electronics. The switch has been designed to replace mechanical switches in temperature sensing and control applications by integrating the temperature sensor along with a voltage reference and all required circuitry to form a stand-alone temperature switch. Key features include a user-programmable temperature set point, 4.5V to 18.0V power supply range, an ambient tem-

perature range of –40°C to +85°C, and space-saving 8-pin DIP and SOIC packaging.

The TC622 and its lower operating-voltage companion TC624 (2.7V to 4.5V) are suitable for use as cost-effective thermal control integrated circuits. Applications include thermal management for all high performance microcontrollers and microcomputers, power supplies, consumer appliances, automotive and industrial temperature control, and battery overheat detectors in portable equipment. Both devices feature very low supply current making them suitable for many portable applications. [810](70)

ENTER 2404 ON CARD

Panel PC

Recently released by Acrosser Technology is a very compact panel PC, the AR-M9718, available from Backplane Systems. The unit incorporates a 10.4in colour LCD with optional touch screen, in-built power supply and 7-slot passive backplane. Front access is available to the power switch, floppy disk drive, printer port, display controls and keyboard and there is internal space for a hard disk drive. Hold down clamps protect cards from vibration and the cooling fan has a removable air filter. [387](5905)

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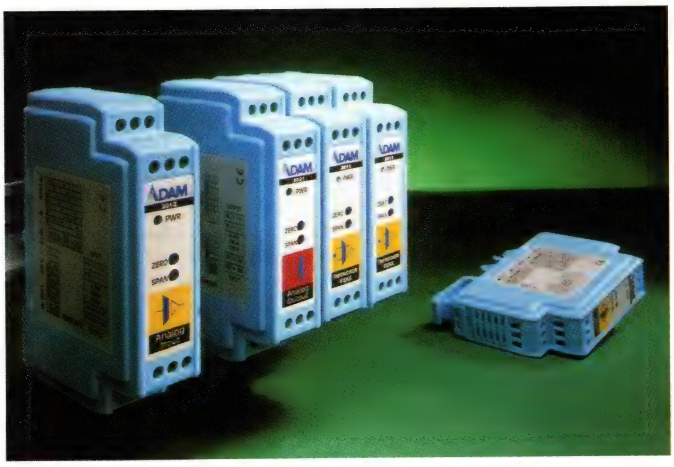
Signal conditioning modules



Priority Electronics has released ADAM-3000 signal conditioning modules for processing a wide range of signals, and for protecting instruments from the harmful effects of ground loop, motor noise, and other electrical interference. Featuring new optical isolation technology, the modules provide three-way (input/output/power) 1000Vdc isolation. Optical isolation provides pin-point accuracy and stability over a wide range of operation at minimal power consumption.

Modules in the series accept voltage, current, or thermocouple as input and pass voltage or current as output. Thermocouple input is handled by the built-in thermocouple input linearisation circuitry and cold junction compensation, which ensure accurate temperature measurement and convert thermal information to its proportional voltage.

The modules are easily mounted on a DIN rail, and signals are connected through a screw terminal which is built into the industrial-grade plastic chassis. The +24Vdc input power can be conveniently routed through adjacent modules. With simple two-wire input/output cables, wiring is easy and reliable, even in harsh industrial environments. [795](6090)

ENTER 2406 ON CARD

Industrial PC chassis

The AR-IPC6xx series of industrial PC chassis from Acrosser Technology comprises modular industrial chassis that combine card cage and power supply in one unit. Available from Backplane Systems, the units have a 6-slot passive backplane and are available in two sizes, the LP model for full length cards, and the MP model for half length cards.

The LP model has a 200W power supply, while the MP model has a 130W power supply. Both are wide range input (90Vac to 264Vac) with overload protection, and have provision for mounting two 3.5in drives, a hold-down clamp and front panel indication for power, hard drive activity and watchdog status, as well as a reset switch and speaker.

Two filtered fans are provided, one for the power supply section, and one for the card section. These units will find applications as remote terminal units for PC-based data acquisition and control systems, compact wall-mounted system nodes, OEM systems enclosures, etc. [1250](5905)

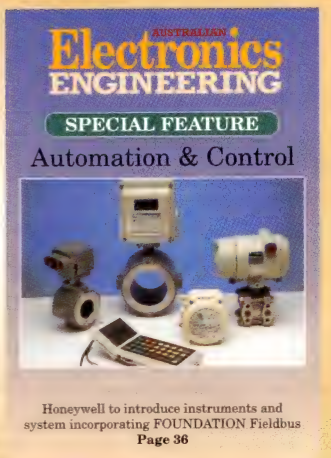
ENTER 2407 ON CARD

BEHIND THE FEATURE COVER

Fieldbus is the next-generation digital bus for control and remote instrumentation applications. **Honeywell Industrial Automation and Control** is set to introduce a portfolio of FOUNDATION fieldbus-compliant products and a system incorporating fieldbus later this year. Products include smart pressure and temperature transmitters, a smart magnetic flowmeter, a smart gas chromatograph and a smart valve interface. Honeywell will also provide a fieldbus configuration toolkit. In addition, Honeywell plans to introduce FOUNDATION fieldbus on its advanced PC-based SCAN 3000 control system.

Honeywell played a key role in the formation of the FOUNDATION fieldbus standard, but it views the technology as an enabler, not an end in itself. For fieldbus to be of value to the user, it has to be seen as a pipeline of data for applications and services. That is why fieldbus will become an important component of Honeywell's TotalPlant open solutions for the process and control industries.

For information contact Honeywell **toll free on 1800 658 412.** [795](7259)



ENTER 7419 ON CARD

PCI/IEEE 488.2 board with digital I/O

Iotech has announced the latest addition to its IEEE 488 controller line — the Personal 488/PCI, a high speed, PCI-based IEEE 488.2 instrument controller, which is supported by Iotech's complete line of software drivers for Windows 95, Windows NT, Microsoft Win-

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dows 3.x, and DOS. Available from Scientific Devices, the Personal 488/PCI drivers support user-written applications in an array of development languages such as C, Visual Basic, Borland C++, and LabVIEW. The 32-bit Personal 488/PCI features true plug and play compatibility and provides IEEE488.2-compliant data transfer in excess of 1 Mbyte/s.

The controller transfers data in excess of 1Mb via the IEEE488.2 handshake protocol and automatically generates and detects termination characters to further improve the 488 bus throughput. It also transfers data at up to 133Mb across the PCI bus, and offers 8 lines of onboard digital I/O. It can accommodate 8 TTL-level digital input or output signals. [370](103)

ENTER 2408 ON CARD

Soldering robot

I&J Fisnar has introduced the benchtop I&J500-S Soldering Robot. Available from Machinery Forum, the programming controls for the soldering function allow for solder wire to be fed at differing rates and differing lengths, and the preheating and soldering time of the soldering-iron module are easily programmable. The operating temperature is controlled by push-button programming of the PID controller on the front of the soldering unit. The control of these parameters allows for repeat soldering results of many point to point and slide soldering applications.

The robot's variable Z-axis height control allows for soldering at different heights. Soldering speeds can be programmed for each point.

The unit is suitable for automation of a wide range of soldering applications. [2300](1640)

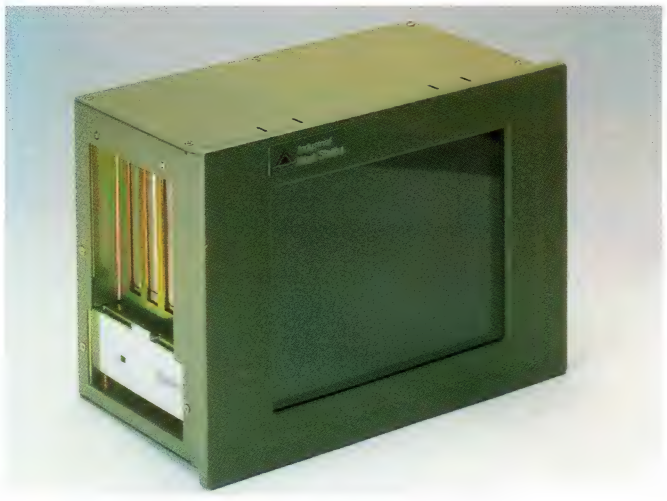
ENTER 2409 ON CARD

Absolute encoder for industrial robotics

Amtex Electronics has announced the release of an absolute encoder from LCSP. Called the Stegmann AG100 MSSI, it has been developed for use on industrial robots. Its use is advantageous in robotics due to the high gear ratios required by the servo motor in providing motion to the robot arm. It is better suited than an incremental device for two other important reasons: better immunity to electrical noise, and the ability to provide a true position without having to be reset to a home reference point. The true location will be signalled as soon as power is applied, even if the encoder was moved while the power was off. A loss of position could result in a collision of equipment or injury to a bystander.

Two versions are offered: a pure hardware encoder for dynamic positioning applications, and a programmable version for applications requiring specific resolutions or electronic offsets. This multi-turn encoder features 24-bit resolution with maximum counts of 4096 steps per revolution and 4096 revolutions. The design features cost-effective synchronous serial interface (SSI) for data transmission. It is designed with shaft, housing and connector seals which are IP65 rated. It has an extended operating temperature range of –20°C to +85°C and is available with or without a safety limit switch.[795](2807) **ENTER 2410 ON CARD**

4-slot panel PC



The AR-M9700 series of panel PCs from Acrosser Technology comprises compact units that meet all the requirements for an industrial man-machine interface. Available from Backplane Systems, their heavy-duty steel chassis and a sealed aluminium alloy front panel (NEMA 4/12) meet the toughest industrial and environmental protec

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Embedded control computer

Engineers can develop C-language programs on Z-World's Micro-G2 embedded-control computer, right in their target system without the aid of in-circuit emulators or logic analysers. Available from Dominion Electronics, this small but powerful embedded computer measures only 81x58x12mm, yet its basic version provides 26 digital I/O channels, both RS-232 and RS-485 networking, as well as connections for an external backup battery. The Micro-G2 can accommodate real-time, multitasking programs having as many as 20,000 lines of C.

The unit's Z180 microprocessor (an enhanced Z80) runs at 9.216MHz and can address as much as 1Mb. Depending on options, data-memory capacity ranges from 32 kbyte to 512 kbyte of battery-backed SRAM. Either UV-erasable EPROM (32 kbyte to 512 kbyte) or Flash EPROM (128 kbyte to 256 kbyte) is available for program storage. Optionally, a 12-bit A/D converter provides four 0-2.5V analogue input channels, two with signal conditioning. A real-time-clock IC is also available. A standard on-board 5V regulator accepts 9-12Vdc and the board draws 80mA. [387](8671)

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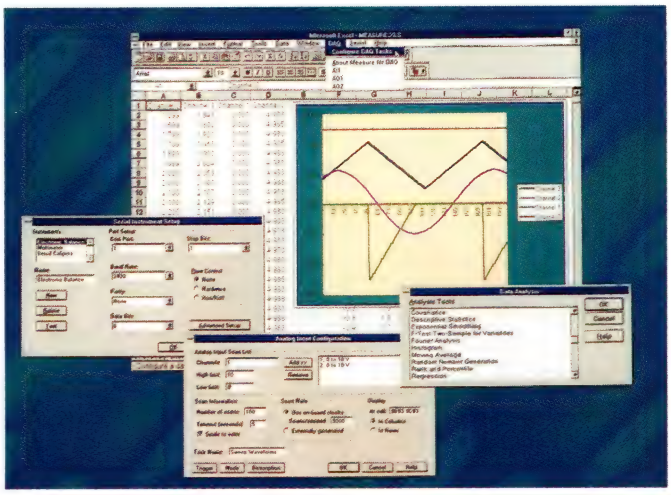
Direct data acquisition and serial control for Microsoft Excel



National Instruments has announced a spreadsheet add-in for direct data acquisition and serial control for Microsoft Excel. Measure software for Windows combines the analysis and report generation capabilities of Microsoft Excel with easy-to-use, interactive menus for controlling plug-in data acquisition (DAQ) boards or serial measurement devices. Through the interactive Measure menus and dialogue boxes, users can quickly and easily configure and execute acquisition operations.

Using Measure, scientists and engineers can take single-point, low-speed readings for temperature, pressure, or process monitoring applications using National Instruments PC DAQ hardware,or acquire high-speed waveforms for electronic testing or signal processing applications. In addition, users can send remote commands or acquire and parse data from any analytical measurement device using a standard computer serial interface or plug-in serial interface board. Measure gives scientists and engineers using Excel fast and easy data acquisition capabilities for analysis and report generation in analytical chemistry, physiological research, process monitoring and control, design characterisation, quality assurance, and electronic testing. [384](9180)

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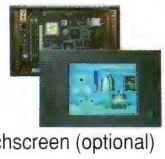

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The age of the fieldbus

The development of an interoperable, digital bus standard for field instruments in control applications has been a long-time industry dream. *Mike Santori* and *Kurt Zech* reflect on the much-delayed development of such a standard — the FOUNDATION Fieldbus.

Benchtop instrumentation has long had the benefit of standardised digital communications. IEEE 488 has given test system designers a common, well defined instrumentation interface for 20 years. The process automation world, however, has not had the benefit of such a digital standard. The 4-20mA current-loop analogue standard is the current standard for connecting instrumentation (pumps, valves, temperature transmitters, etc) in a process control system. This standard constrains the information a system can receive from an instrument to a single reading that reflects the primary process value of the device. In this type of system, there is no standard mechanism to read additional information, such as pressure and flow, from a single device or data relating to diagnostics and calibration. Many digital communications networks are used in the process environment, but they are for the most part either proprietary or have not yet seen widespread acceptance.

Standardised digital communication networks are arguably the hottest topic of discussion in the industrial automation world today — for a variety of business reasons, companies are looking to use such communications in their control systems. The term fieldbus is often used to refer to an all-digital communication network for use in connecting process instrumentation to control systems. Formal fieldbus standardisation activities have been underway for nearly 10 years, but have not yet produced a standard.

Many so-called fieldbus systems are under development and in use outside the formal standards process. One bus, under development by the Fieldbus Foundation, has a particular focus on interoperability. Key functional aspects of the FOUNDATION Fieldbus, the bus under development by the Foundation, ensure that devices can easily share data and execute standard functions in a control system.

Today's environment

In today's process environment, control information is largely considered as the data needed to control the process. As the scope broadens from controlling the process to managing the process and the business, the information requirements change from control data only to both control and non-control information. Although there will be increases in control information, there will be much larger increases in non-control information. For example, manufacturers today are faced with stringent regulatory and quality requirements. Many changes in the process industries are driven by the need to comply with new EPA and OSHA requirements. In addition, most process manufacturers have to conform to ISO 9000 quality requirements to do business in Europe. These regulations require companies to determine the best operating practices and to document them.

Because field devices are the foundation of a control system, more information will be required from them. This includes information about the devices, such as maintenance and calibration, as well as information about the process itself. Because improvements are going to be required in every phase of the automation life cycle, more than just operation and control information are needed for businesses to be competitive and successful. Access to non-control information will enable companies to make quick, accurate business decisions that will optimise plant and business performance.

The topology today for field devices and control systems is a mixture of technologies (*Figure 1*). These technologies can be divided into the following three major categories.

- **Traditional analogue and discrete I/O devices** — These devices connect to an I/O system or controller using an analogue 4-20mA current signal. Examples of 4-20mA use include temperature measurements from thermocouples and RTDs as well as discrete I/O (on/off) signals for motor starters, limit switches, solenoid valves, indicators, and switches. Traditional 4-20mA devices are used with distributed control system (DCS) and programmable logic controller (PLC) I/O subsystems.
- **Hybrid analogue and digital devices** — This class of devices works with both 4-20mA and digital communications. An example of such a protocol is HART (highway addressable remote transducer),

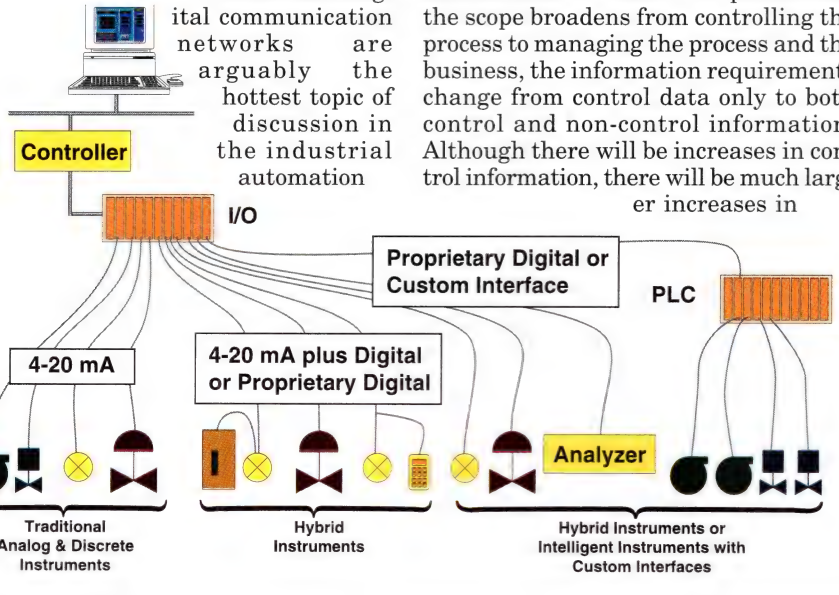

Figure 1. Control systems today use a combination of analogue and digital interface to connect to instrumentation.

which superimposes a digital communication signal on top of a standard 4-20mA analogue signal. Although the basic HART protocol is well defined, many of the instruments that fall into this category use proprietary commands and can only be connected to control systems from the same supplier as the field instrument. Many of these devices are 2-wire devices and are usually connected in a point-to-point topology.

• **Hybrid digital devices** — Many devices have open, non-proprietary interfaces but require custom hardware interfaces and custom software drivers in the control system. These devices include weigh scales, bar code readers, analysers, supervisory control and data acquisition (SCADA) systems, PLCs, and even some intelligent valves. The biggest disadvantage of this class of technology is the need for custom hardware interfaces and custom software drivers. These types of protocols and connections include interfaces such as Modbus, RS-232, RS-485, and ASCII.

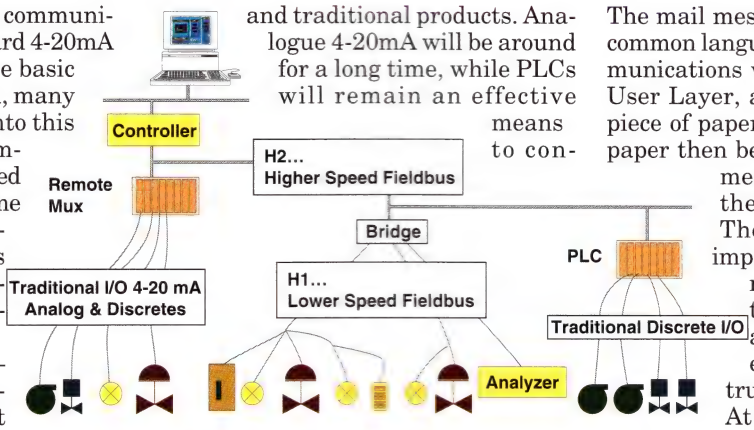

Figure 2. A control system using fieldbus can use the multidrop capabilities of fieldbus as well as continue to use point-to-point connections on existing wiring.

Fieldbus defined

Fieldbus, an all-digital, high-performance, multidrop communications protocol that replaces the three topologies discussed above, is an enabling technology that allows suppliers to develop products that can interoperate with one another as well as with control systems. Although fieldbus is often thought of as the replacement for 4-20mA, it is much more, simply because it replaces all three topologies discussed previously. Fieldbus is often referred to as high performance because it provides performance and data transfers that are 10-20 times faster than the hybrid protocols of today for smart transmitters and valves. In addition, fieldbus is multidrop, meaning that more than one device can be connected on the same single pair of wires for device communications and device power.

The fieldbus topology resembles traditional topology in some ways, but is also very different (*Figure 2*). It is comprises two basic parts: a lower-speed fieldbus, often called H1; and a higher-speed fieldbus, often called H2. These two fieldbus parts can be connected together via a device called a bridge. Although H1 is referred to as the lower speed fieldbus, it still offers performance that is roughly 10-20 times higher than the hybrid protocols of today for smart transmitters and valves. Fieldbus-based systems in the future will not be solely based on all fieldbus products, but rather a combination of fieldbus-based products and traditional products. Analogue 4-20mA will be around for a long time, while PLCs will remain an effective means to connect to a multitude of discrete I/O devices. In addition, it will take time for manufacturers to develop a complete portfolio of fieldbus-based products. Note from *Figure 2* that while fieldbus handles multidrop capability, where several devices are connected on the same pair of wires, fieldbus also works with simple point-to-point capability just like a 4-20mA system, where each device has its own individual direct connection to the DCS.

Figure 3 shows a model for the fieldbus communication protocol stack. The services of the fieldbus communication stack are based on the OSI 7-layer model established for communications networks. The fieldbus model does not exactly conform to the 7-layer model. It is missing layers 3-6, which are the network, transport, session, and presentation layers. Many of the functions in these layers are included in the fieldbus data link layer, or the fieldbus application layer, or in fieldbus device applications. They were omitted as specific layers for performance reasons. Fieldbus adds a very important layer, called the User Layer, onto the application layer. This will be discussed later.

In *Figure 3*, the services of the fieldbus protocol are compared to the postal system to illustrate the role of each portion of the protocol.

The mail message must be written in a common language or no meaningful communications will take place. Below the User Layer, a message is written on a piece of paper by a person or user. The paper then becomes important, not the message itself. The paper is then placed in an envelope. The envelope then becomes important, not the paper or the message. The message is then placed in the mailbox, a flag set to indicate delivery, and eventually a mail truck comes by to pick it up. At this point, it doesn't matter what route the mail takes, or what post offices it is routed through. The postmaster coordinates pickup and delivery. The message is transported independently of the message on the paper. Finally, the envelope arrives at its destination. It is carried to the person or user to which the envelope was addressed. When the person reads the message, meaningful communications take place, but only if it is written in a common language. The message may contain information for the user at the destination, or it may request information from the user at the destination (or both). The fieldbus protocol and services are simply a mechanism to assure reliable digital communications between two devices or between a field device and a DCS, for example.

Beyond the basic physical wiring required to connect devices and control systems, the most important element of the fieldbus is that the devices must use a common language or no meaningful communications will take place. The User Layer in fieldbus is the common language, the element of fieldbus that enables meaningful communications to take place. From a user point-of-view, the elements below the User Layer don't matter that

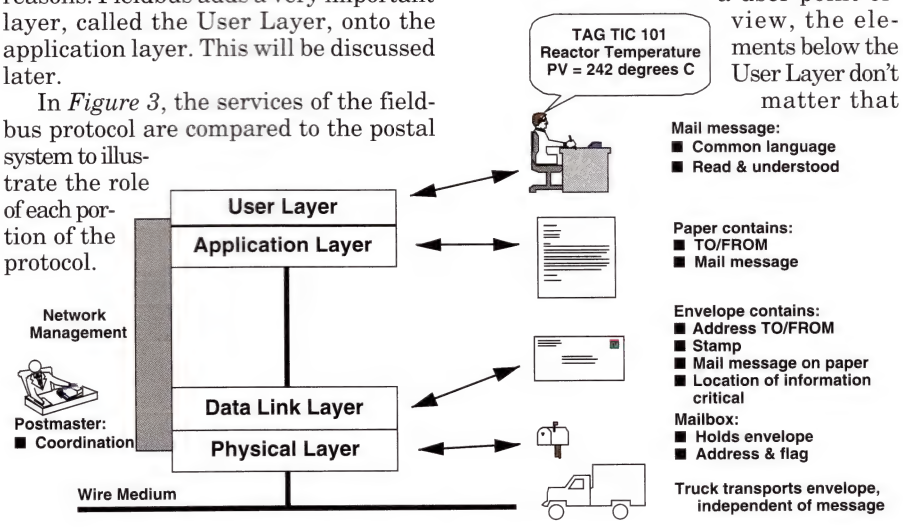

Figure 3. The functionality of fieldbus and its protocol layers are analogous to the services used in the delivery of mail by the postal system.

much. They do need to work as expected and be efficient and reliable. The important element is that a fieldbus solution is required to provide communications between devices and host systems to enable fieldbus-based, digital products.

A brief history

To illustrate the specific capabilities of fieldbus, we're going to describe the fieldbus under development by an organisation called the Fieldbus Foundation. Before doing this, however, it is informative to look at the history of fieldbus. There are two organisations working on the fieldbus standards specifications. They work together as one committee, but each group has different voting and approval mechanisms. The two groups are the International Electrotechnical Committee (IEC) and the ISA International Society for Measurement and Control, (formerly the Instrument Society of America). The IEC committee for fieldbus is IEC TC65 WG6 (Committee 65 Working Group 6); each IEC member country has one vote. The ISA fieldbus committee is SP50 (Standards and Practices Committee 50), where each participating company has one vote but voting must be balanced between suppliers and users. Formal standards activity have been underway in the ISA SP50 committee since 1984.

The Fieldbus Foundation

To bring a close to the delays and frustration, the Fieldbus Foundation was announced in June 1994 and incorporated in September 1994. The Fieldbus Foundation was created as a merger of two major industry fieldbus organisations — The Interoperable Systems Project Foundation (ISP) and WorldFIP/North America. Both of these organisations were developing solutions to meet the requirements of fieldbus while building on existing standards. The ISP was based largely on ProfiBus, a German national standard. WorldFIP is based on FIP (Factory Instrumentation Protocol), a French national standard. Many users objected to the situation in which there were two large competing organisations developing fieldbus standards. For this reason, ISP and WorldFIP/North America agreed to merge in order to produce a single international fieldbus standard. Fieldbus Foundation has worldwide membership that represents about two-thirds of the equipment supplied to the process industries and about half of that supplied to factory automation.

The Fieldbus Foundation has a set of guiding principles that are all focused on the goal of delivering a single, international, interoperable fieldbus standard. These principles are as follows:

- Fieldbus is an enabling technology that by itself does not provide a solution. It will enable suppliers to develop products and solutions that provide many advantages to end-users as well as many opportunities for new and innovative products for suppliers.
- The Fieldbus Foundation solution must be open and interoperable. This means that end-users have the freedom of choice in their fieldbus products and systems and suppliers have a level playing field on which to compete and develop differentiated products and solutions.
- Fieldbus technology should be independent from the control of any single supplier.
- Existing technology will be used wherever possible. The FOUNDATION Fieldbus is based on work completed in the IEC/ISA committees and supplemented with proven, existing technology that comes from IEC/ISA SP50, ProfiBus, FIP, and the HART protocol. The Fieldbus Foundation companies continue to support IEC/ISA SP50 standards efforts, in many cases with more engineering resources than ever before.

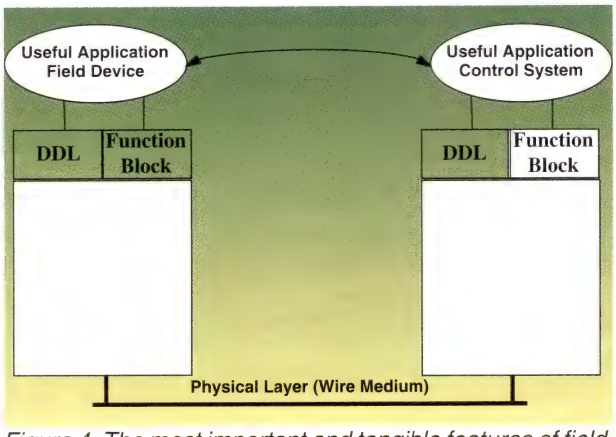

Figure 4. The most important and tangible features of fieldbus for users are the Physical Layer wiring and the software services provided in the User Layer. The details of intervening services are not important, as long as they are robust and reliable.

FOUNDATION Fieldbus

Figure 4 shows a simplified picture of the FOUNDATION Fieldbus. Note that this figure focuses on the top and the bottom of the fieldbus protocol. These are the parts of the fieldbus that are really important to end-users because this is where a user comes into contact with the fieldbus system. The other layers must be in place to assure reliable and timely communications between two devices or between a device and a control or host system, but they are invisible to the fieldbus user.

A key focus of the Fieldbus Foundation is interoperability. Interoperability means not only the simple ability to exchange devices and ensure basic communication, but also application-level commonality that allows users to view and use the capabilities of their devices in a standard way. The User Layer is the most important part of FOUNDATION Fieldbus because it defines the software model for how users interact with the system. There are two key components of the User Layer — Function Blocks and Device Descriptions.

Function blocks are important for consistent operation and engineering in a fieldbus system. The Fieldbus Foundation function block specifications define a set of inputs and outputs as well as a mode structure and alarm/event subsystem for common control system functions. *Figure 5* shows the model of a function block and lists the 10 function blocks that comprise the current FOUNDATION Fieldbus specification.

Function blocks are a consistent, easy-to-use, block-oriented model for configuration of and interaction with standard control system functions. Fieldbus devices will come configured with the ability to perform some set of function blocks. The integrator of a control system creates his control strategy by configuring the function blocks in the system to execute and communicate at scheduled times. From a high-level point-of-view, the system is viewed not as a collection of instruments but as a collection of function blocks. Thus, they present a more application-oriented model than is presented by a set of devices that have unique data structures or command sets for performing I/O and control operations.

In today's control systems, most of the actual control strategies are executed in the control system as opposed to the devices themselves. The controller reads values from the devices, performs the control algorithm, and outputs control signals to other devices. The use of an all-digital communication network enables the development of more intelligent field devices that can potentially perform control directly. With the development of such intelligent devices, function blocks permit the distribution and integrated execution of process functions to the devices themselves. Function blocks provide the consistent definition of the information to be communicated and the functions that will be distributed within the field devices. Phase 1 of the FOUNDATION Fieldbus defines the initial 10

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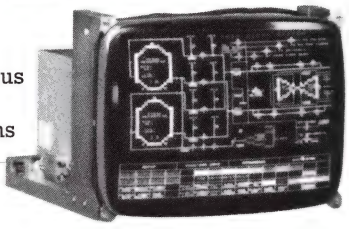

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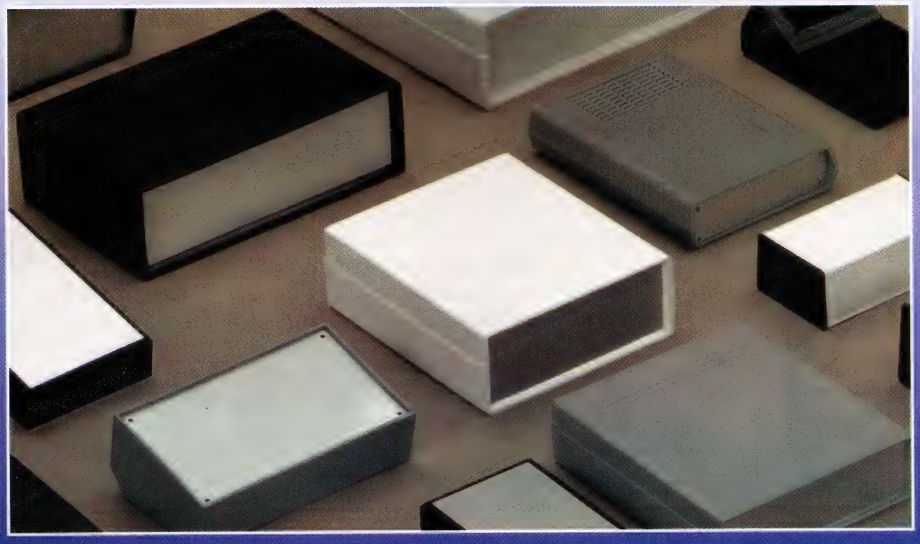

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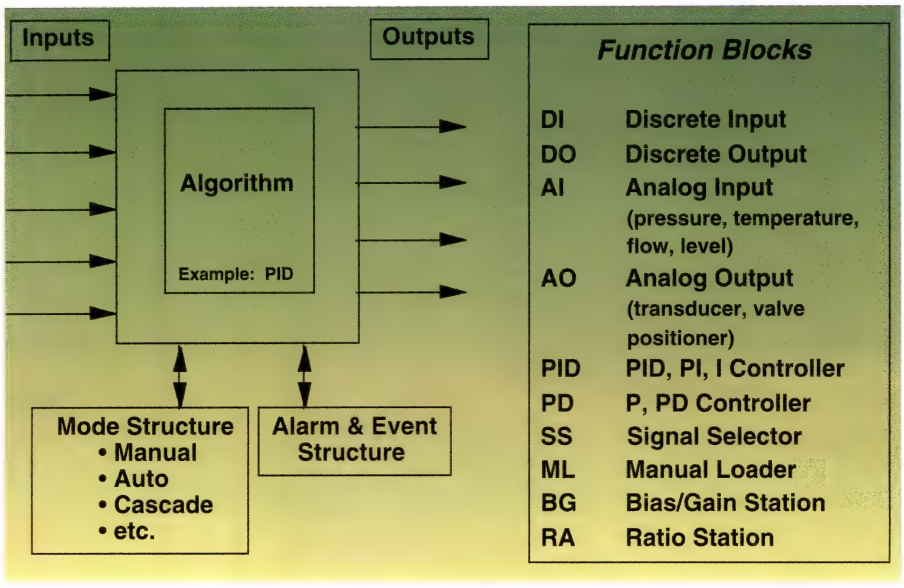

Figure 5. Function blocks provide a standard model of control system capabilities and ensure consistency for users in process operation and engineering.

function blocks listed in *Figure 5*. More advanced function blocks are under specification and will be included in subsequent versions of the specification.

The second key feature of the User Layer is the Device Description. In today's systems, there is no standard mechanism for describing the capabilities of a field device. Such information is described either in the printed documentation of the device or available in proprietary electronic formats. Thus, a user must have prior knowledge of the particular formats used by each device in their system to take advantage of particular instrument capabilities.

Device Descriptions are a standard mechanism that permits a host system or control system to acquire the definition of messages from a field device. With a Device Description, the user can use software tools to learn characteristics such as vendor name, software revisions, available function blocks, and diagnostic capabilities. With existing devices, each device has different mechanisms for determining this information. Device Descriptions eliminate the need to revise host system or control system software when the user wishes to incorporate revisions to an existing device or add a new device to the existing system. Device Descriptions are developed using a C-like language called the Device Description Language (DDL).

A more important long-term benefit of Device Descriptions is that they foster and encourage product innovation and development of a new generation of field devices. Because they have a standard way to describe the functions of their devices, vendors can safely add new and innovative features and be confident that these new features are easily accessible to existing systems and users. Contrast this approach to one in which interoperability is achieved by deciding in advance the specific functions for classes of devices. Such an approach would require either constant updating of the class definitions as new capabilities were added or a proliferation of derivatives or supersets of the classes. This situation would tend to discourage the addition of new capabilities because of the potential for users to not have the ability to easily access the features. Also recall that a key long-term benefit of fieldbus is that it will encourage the development of more intelligent devices which, by definition, includes capabilities not previously included in a given type of device.

Fieldbus promises to revolutionise the way that control systems are built today, enabling communication between many types of devices and control systems. This gives users the freedom to choose the equipment most suited to their application needs rather than the capabilities or restrictions of a particular vendor's control system. The capabilities of digital communications enable vendors to use innovation in their device designs and deliver more functionality to meet the control and non-control needs of today's business environment. The FOUNDATION Fieldbus delivers the benefits of fieldbus while ensuring that interoperability is an integral part of the technical standard. ❐

Mike Santori is Industrial Automation Marketing Manager for National Instruments, and Kurt Zech is an applications specialist with the Fieldbus Foundation.
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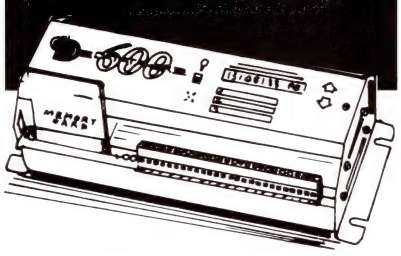

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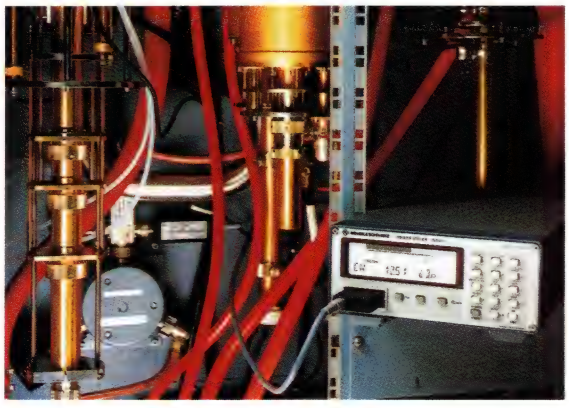
Fundamentals of RF power measurement

In the high-frequency RF realm the measurement of power is all important. This article looks at the fundamentals of RF power and the equipment used to measure it.

The measurement of electrical power in RF and microwave applications has the same significance as voltage measurements in electronics or in electrical engineering. Power meters are used for a wide variety of tasks and are indispensable in the lab and test department. In comparison with spectrum or network analysers, they are relatively unsophisticated instruments. However, the great progress that has been made in devising refined procedures for correcting probe errors over the last ten years is largely overlooked. In spite of this, the application of probes is limited on account of the inherent physical factors. Selecting an unsuitable probe is still the most frequent cause of errors in the measurement of RF power.



A second major source of error is the loading effect of the measuring equipment on the circuit under test. Effects of this kind can even occur at standard line interfaces where they mostly go undetected. When a power measurement is carried out correctly these errors become evident because the measurement errors themselves are considerably smaller.

Fundamentals

The development of carrier-based telecommunications at the beginning of this century saw a parallel development in the field of RF voltage, current and power measurements. The majority of methods were based on converting electrical energy into heat. For a long time, this was the only way of making accurate measurements at practically any frequency. In the meantime, direct voltage and current measurements can be made into the GHz range without having to convert electrical energy into heat. Nevertheless, the intensity of RF and microwave signals is still given in terms of power. Apart from the high accuracy of thermal power meters, there are other important reasons for using power.

Any signal transmission by waves, for example sound propagation, involves the transfer of energy. Only the rate of energy flow — power — is an absolute measure of wave intensity. In the RF and microwave ranges, the wave properties of the electromagnetic field play an important role because the dimensions of the lines and subassemblies used are of the same order of magnitude as the wavelength. This fact has to be taken into account when the quantity to be measured is selected. Voltage and current are less appropriate because they depend on the physical characteristics of the transmission medium (dimensions, dielectric constant, permeability) and field strength. Consider, for example, two matched coaxial cables with characteristic impedances of 50Ω and 75Ω. For the same transmitted power, the voltage and current for the two impedances differ by a factor of 1.22.

There are further reasons for selecting power as the quantity to be measured. There is no direct way of measuring voltage and current in wave guides, and when standing waves occur, there are large measurement errors. And of course power handling capacity is a crucial factor that determines system or equipment design. All the components in a power transmitter or amplifier, from the ac line connector, through the cooling system to the coaxial RF output, depend on the magnitude of the RF power.

The commercial aspects of measuring very high power, say in a TV transmitter, are also worth mentioning. Every percent of measurement error represents a relatively large power which has to be paid for. A manufacturer of a transmitter with a specified power of 10kW may have to build in an extra 100W of RF power for every 1% measurement error to cover himself on acceptance.

Definition of electrical power

Power is usually defined as the rate of transfer or absorption of energy in a system per unit time. The power transmitted across an interface is then the product of the instantaneous values of current and voltage at that interface (*Figure 1*):

$p(t) = v(t) \times i(t)$

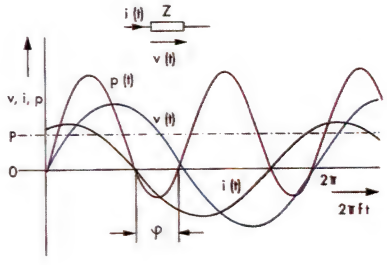


Figure 1. Power absorbed by passive two-port network with a sinusoidal signal applied (v, i, p = instantaneous values of voltage, current and power, P = average power).

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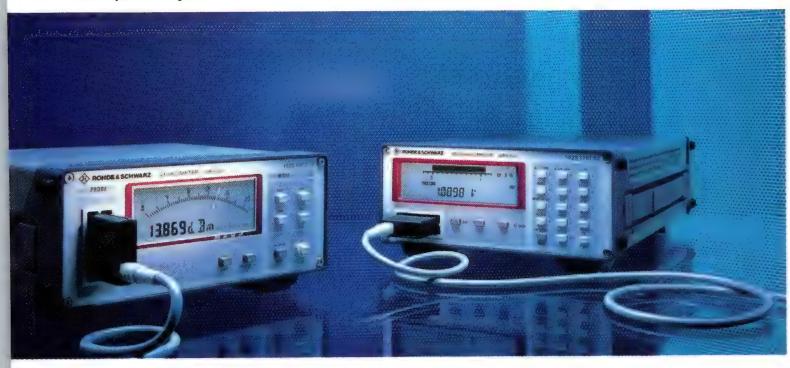

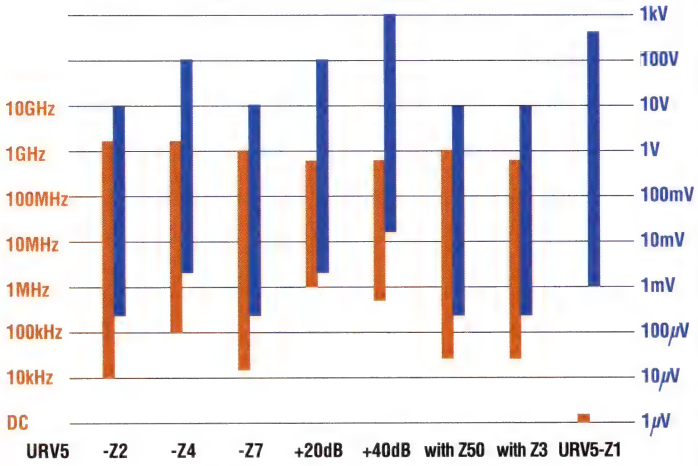

Voltage probe selection guide

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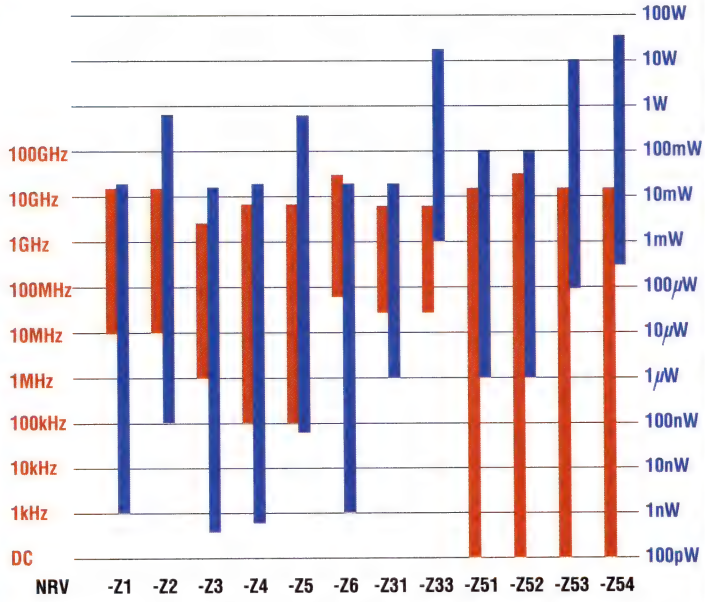

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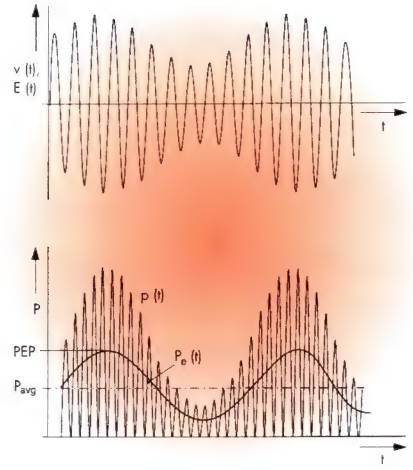


Figure 2. Envelope of modulated microwave signal. Top: voltage/field strength. Bottom: instantaneous power p(t), envelope power P_e(t), peak envelope power (PEP), *and average power* P_{avg}.

In the case of the sinusoidal signals encountered in RF and microwave engineering, the instantaneous power p(t) oscillates about the average power at a frequency that is twice that of the original waveform. Only the average power can be measured in practice and is referred to as power **P**. **P** is related to the RMS voltage **V**, the RMS current **I** and the phase **Ø** by the following equation:

$$P = V \times I \times \cos Ø$$

To avoid confusion with other power definitions, **P** is referred to as the true or active power.

When modulated sinusoidal signals are considered, other definitions of power are more appropriate (see *Figure 2*). The average of **P** over the modulation period is called the average power P_{avg}. This is what would be indicated by a thermal power meter.

The power averaged over the period of a carrier is referred to as the envelope power $P_e(t)$. It varies in time with the modulation frequency. The maximum envelope power is referred to as the peak envelope power or PEP. PEP is an important parameter for specifying transmitters. PEP and the envelope power can only be measured with peak or envelope power meters which use fast diode sensors.

Power P	Level L_{abs}/dBm
1 pW	-90
1 nW	-60
1 µW	-30
1 mW	0
1 W	+30
1 kW	+60
1 MW	+90

Table 1. Relative power levels.

A different approach may be used for RF bursts. If the duty factor tp/T is known, the peak power can be calculated from the average power P_{avg} (shown in *Figure 3*). To distinguish it from the peak envelope power it is referred to as the pulse power P_p.

$$P_p = P_{avg} / (tp/T)$$

Units and power level

Because of the large power ranges that have to be measured, values are usually expressed as the log of a power ratio. A relative power level Lr is expressed in terms of the log of the ratio of a power P to an arbitrary reference power P0; the units are dB:

$$Lr = 10 \log_{10} (P/P0) \text{ dB}$$

Absolute power level L_{abs} is referred to 1mW and measured in dBm:

$$L_{abs} = 10 \log^{10} (P/1mW) \text{ dBm}$$

$$P = 1 \times 10^{Labs/10dBm} \text{ mW}$$

A list of corresponding absolute and relative power levels is given in *Table 1* with a range of values of 10^{18}.

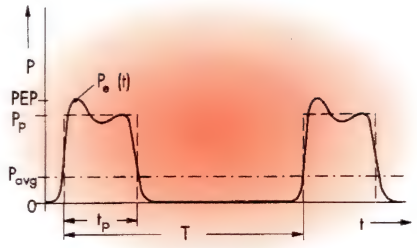


Figure 3. Pulse power P_p (dashed line).

Power meters

RF power meters have to satisfy a large variety of requirements. In addition to a wide frequency and power range, low measurement uncertainty is above all a desired factor. With the introduction of digital radio networks there is an increasing demand for measurements of modulated signals, from the simple determination of the peak value through to detailed analysis of the envelope. Moreover, monitoring of the incident and reflected power should be possible as well as determination of the power available from any kind of source. Different types of power meters are available to cover all these requirements.

Terminating or absorption power meters are versatile instruments allowing measurements of high accuracy, particularly in conjunction with thermocouple sensors. Connected to the output of a source, they measure the available power. In conjunction with directional couplers, power splitters and SWR bridges, they are also suitable for directional power measurements, attenuation and SWR measurements and they can be used as calibration standards. Usually, the power absorbed in the termination is measured with the aid of a thermocouple or diode sensor. In this way, the average power and, using appropriate diode sensors, the peak power can be measured.

Peak power or envelope analysers with power sensors based on fast diode sensors enable measurement of the envelope power. They are ideal for in-depth analysis of modulated signals as can be found with radar equipment, nuclear

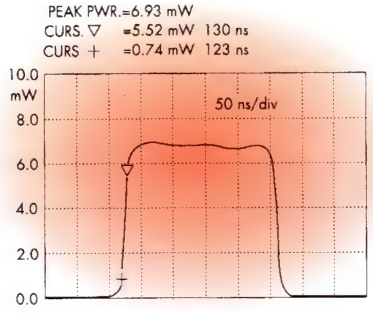
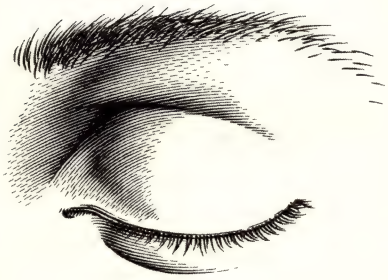


Figure 4. Typical envelope power meter display.

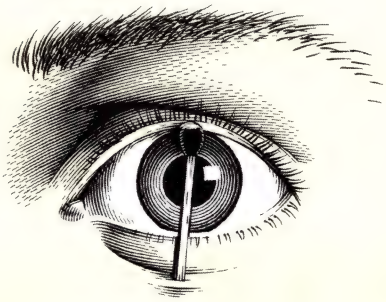
spin tomographs, TDMA radio equipment, etc. Comparable with a digital oscilloscope, they are able to detect single and periodical changes of the envelope power. They feature a large variety of trigger facilities, screen display of the results, cursor readouts and the like (*Figure 4*).

Directional power meters or feedthrough power meters are available for in-service measurements on antennas, radio equipment or other high power RF generators. A dual directional coupler (reflectometer) built into many of these meters enables monitoring of incident and reflected power and hence SWR measurements under operating conditions. The difference between incident and reflected power is always equal to the power absorbed by the load. Unlike the incident and reflected power, it is not dependent on the characteristic impedance of the directional power meter and is therefore correctly measured even when the characteristic impedance of the test setup is different from that of the power meter or there is no defined reference at all. ❐

This article was supplied by Rohde & Schwarz Australia and is adapted from the publication Voltage and Power Measurements — Fundamentals, Definitions, Products *produced by Rohde & Schwarz.*



Ordinary digital scopes are asleep 99.9935% of the time.



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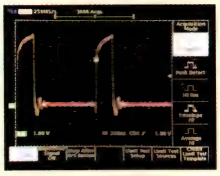

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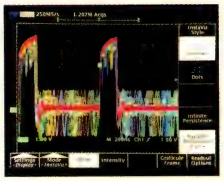

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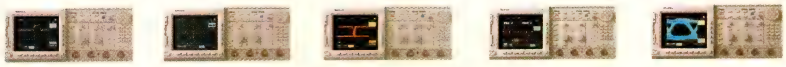

	TDS520B	TDS540B	TDS724A	TDS744A	TDS784A
Bandwidth	500 MHz	500 MHz	500 MHz	500 MHz	1 GHz
Channels	2 + 2	4	2 + 2	4	4
Max. Sample Rate	1GS/s	2 GS/s	1 GS/s	2 GS/s	4 GS/s
Max. Record Length	250K	500K	250K	500K	500K
Max. Wfm. Acquisition Rate	100,000 W/s	100,000 W/s	180,000 W/s	400,000 W/s	400,000 W/s

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VXI*plug&play* standards

Redefining VXI products and test system integration

In an effort to make VXI easier for test system developers, an alliance of companies has developed a series of standards called VXI*plug&play*. *Steve Jennings* looks at the new standards and what they mean for the industry.

In 1987 the first revision of the VXIbus standard was published by the VXI Consortium. The new standards and the equipment they spawned were eagerly accepted by the military and aerospace test community. The advantages of the modular platform, tight system synchronisation, small footprint and multi-vendor interoperability were valued by these users.

While sales of VXI-based instruments grew steadily, a large portion of the test systems market have still not been persuaded to switched from GPIB rack-and-stack systems to VXIbus. Some cite the fact that the instruments they need are not available on the VXI platform. Some builders of small systems are still put off by the price. But the majority of the potential users said that while VXIbus systems offered many advantages, they were hard to use and integrate. This fact was putting the brakes on the growth of VXIbus systems in existing as well as new markets. Even though VXI is an open standard, users found that some combinations of computers, software and instruments were not compatible. Instrument-level interoperability was no problem. It was system-level issues that caused the majority of the customer satisfaction issues.

To tackle the problem it was felt that further standardisation was necessary. Five VXIbus product vendors — Tektronix, National Instruments, GenRad, Racal Instruments and Wavetek — got together in September 1993 and formed the VXI*plug&play* Systems Alliance. These companies sought to solve the system level compatibility issues their customers faced, through increased cooperation and standardisation.

VXI*plug&play* systems standards

The VXI*plug&play* Systems Alliance developed the charter as its first document (VPP-1) to insure a common vision and set of goals by all members of the Alliance. The charter document is supported by all members of the Alliance which now number forty-four at the time of writing. The charter states the purpose of the Alliance, its guiding principles and core technologies. The standards developed by the Alliance are meant to provide an open, multi-vendor system architecture while creating better ease of use, shorter system integration times and lower system costs. These standards are meant to be compatible and complementary to the VXIbus Consortium standards. The charter is what has enabled the Alliance to make swift progress in developing and publishing standards that complement the existing VXI standards and maintain backward compatibility with the installed base of VXI products and systems.

Following is an explanation of the those standards set out by the VXI*plug&play* Systems Alliance which most affect users when developing VXI*plug&play*-compatible systems.

VPP-2 — System frameworks

VPP-2 is a standard that defines system frameworks. A system framework is the definition of the operating environment for software modules (i.e. instrument drivers, soft front panels). Frameworks are defined mainly by the operating system and application development environment that the software modules will operate in. Currently, there are three frameworks defined by VPP-2, while others are still in the development phase. The three current frameworks are DOS, WIN and GWIN. The WIN and GWIN frameworks are the ones currently being focused on by most vendors. The reason for this is the popularity of the Windows operating system with users of VXIbus-based test systems.

The WIN framework consists of the Windows operating system and many of the application development environments that run with Windows. There are presently six environments listed in VPP-2 and they are LabWindows/CVI, Lab-

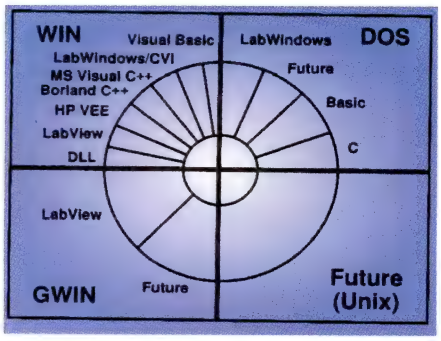
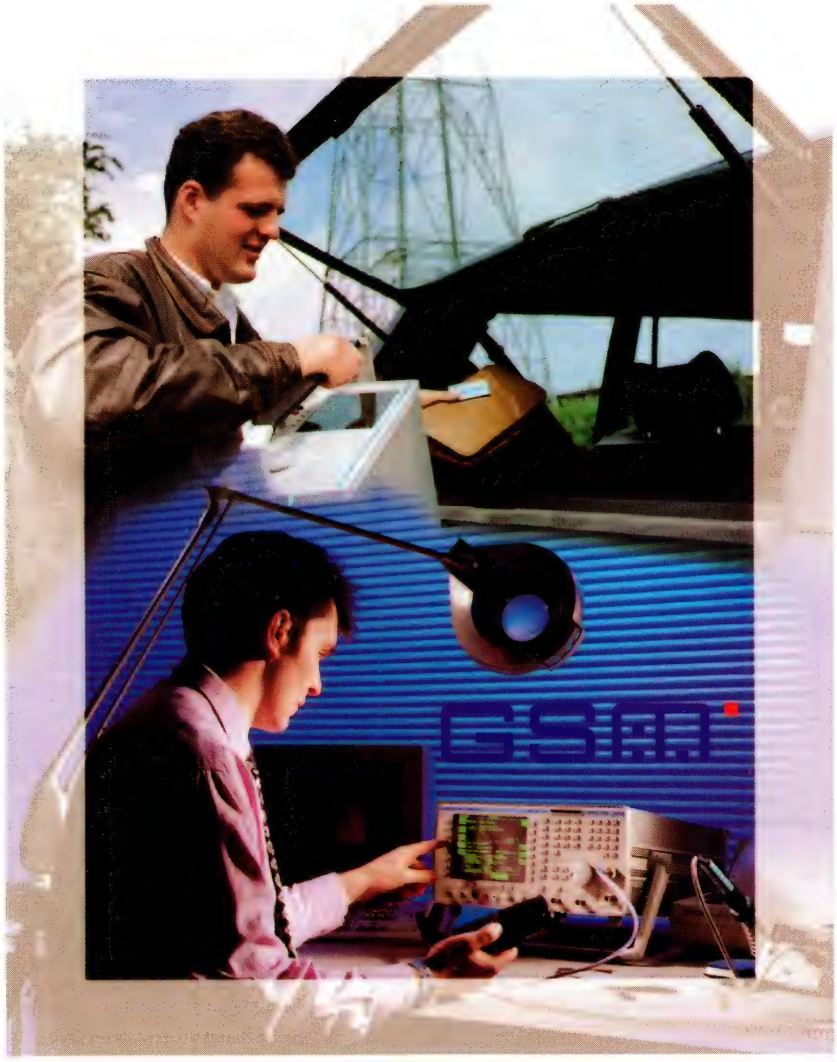


Figure 1. System frameworks.

The all in one test station



The 2966A integrates all essential GSM measurements required in service, production subassembly and assembly, good receiving/ pre-dispatch plus international analog systems (AMPS, TACS and NMT) and the worldwide trunking format (MPT1327).

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The compact, portable 2966A tests all essential RF, audio and DC parameters of a GSM radio in a fast, user friendly way. Built-in automatic tests give rapid results for go/no-go applications.

Standard RF functions, including a spectrum analyser, are invaluable for verifying performance, fault finding or aligning GSM phones.

System parameters can be modified to allow any network to be emulated. Measurements can be made on radios in test modes without signalling.

Essential GSM measurements included as standard

These include receiver testing with BER (Class I and II), RBER (Class Ib and II), frame erasure, accurate and fast power readings that are checked against GSM 11.10 mask, phase/ frequency error analysis and burst timing.

Your investment is future-proofed with E-GSM and Phase 2 power levels already included. Extra facilities for advanced fault diagnosis include measurements on access burst, traffic channel rest mode and Tx/Rx at any frequency.

For service enviroments, the 2966A offers fast result updates for alignment and a unique collection of advanced diagnostic facilities.

Analog measurements in the digital world

This single-unit solution for both analog and digital testing offers benefits in terms of cost, bench space and user training time in service and production environments.

Its sophisticated spectrum analyser also provides analysis of TDMA signals, view the 0.3 GMSK spectrum, IQ modulation alignment, look at IF's and LO's, and tracking generator. Other vital tools included are an oscilloscope, audio spectrum analyser and digital multimeter.

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View, HP VEE, Microsoft Visual C++, Borland C++ and Microsoft Visual Basic. However, any application development environment or language that is compatible with the Microsoft Windows 16-bit Dynamic Link Library (DLL) can be utilised with software modules for the WIN framework. *Figure 1* shows a chart outlining the current frameworks and potential future frameworks being defined by the Alliance.

New frameworks under development include the UNIX and Windows 95 operating systems. Once the user chooses a framework, choices of software modules such as instrument drivers can be selected from vendors.

VXI*plug&play* instruments

VXI*plug&play* instruments need three items to claim VXI*plug&play* compliance. These are a knowledge base, instrument driver and soft front panel that are compatible with the specifications of the framework they were written for.

VPP-5 — Knowledge base

Each VXI*plug&play*-compatible instrument must be delivered with a knowledge base file. This file delineates the instrument's specifications including power and cooling requirements, configuration data and other product specific information. For a product to be called VXI*plug&play* compliant, this knowledge base file must be added to the VXI*plug&play* Systems Alliance database. The Alliance keeps this database so that system integrators can utilise the data to assist in designing the system without having to buy the hardware.

VPP-3.x — Instrument drivers

The VXI*plug&play* standards have redefined what a VXI instrument module is when it ships from a vendor. All VXI*plug&play* compatible instrument modules ship with an instrument driver that operates in the user's selected framework. Today, this is typically a WIN framework driver. Instrument drivers provide instrument functionality at a higher level of abstraction than just the command set and provide a higher level control over the instrument. This capability means the user does not have to become an expert in the instrument's command set and can instead focus on the measurement functions to be performed. This creates ease of use for the user and speeds program development time.

The VPP-3 specification gives guidelines for instrument driver developers. These do not specify the level of functionality available in a instrument driver, only the compatibility requirements and basic structure of the driver. It is up to the vendor to decide how much driver functionality to provide. In less complex instruments, such as a switch, drivers can be comprehensive. Highly-complex instruments require the vendor to make decisions about the functional coverage of the driver.

VPP-7 — Instrument soft front panels

VPP-7 describes the requirements for instrument soft front panels. It is a requirement that an instrument soft front panel written for the appropriate framework be shipped with all VXI*plug&play* compatible instruments. The soft front panel serves two important functions. First, it serves as a tool to help the user determine if the system communication interfaces and instrument are operational. Second, it helps to familiarise the user with the basic functionality of the instrument.

Soft front panels must be executable programs that operate at the operating system (O/S) level rather than from within the development environment as instrument drivers do. This is done to eliminate as much system complexity as possible when first bringing the system together.

Soft front panels are visual representations of the front panel of the VXI instrument. Since VXI instruments do not have traditional user front panels, the soft front panel also serves that purpose.

In the case of a WIN framework soft front panel, the user would plug in the instrument and load the soft front panel via a standard VXI*plug&play* installation procedure. The user simply double clicks on the instument's icon in Windows and the soft front panel program searches for the instrument, reports the slot the instrument is located in and confirms that it can communicate with the instrument. The user then operates the VXI instrument much like a traditional instrument through the soft front panel within Windows. Depending on the host computer configuration, several different instrument soft front panels can be run simultaneously. VPP-7 outlines the requirements for soft front panels, but like the driver specifications, it does not state how a soft front panel should look and feel nor how functional it must be. These implementations are left up to the vendor of the instrument. Once the system is operational, the user then brings up the development environment and relies on the instrument driver for future instrument communication. The use of soft front panels has been proven to save time and therefore cost in hardware and software system integration.

VPP-4.x — Software I/O interface

The VPP-4 series of specifications defines a standard software I/O interface. The lack of a common software I/O interface prior to the forming of the VXI*plug&play* Systems Alliance is what caused interoperability problems between development environments and system hardware. Users believed they purchased an open systems environment when they chose VXI-based products and found they were limited in their system configuration choices for system software and hardware. The VXI*plug&play* Alliance has created the Virtual Instruments Software Architecture (VISA) standard which has unified the industry's various software I/O interfaces. The unification of these different approaches has insured backward compatibility with the previous software I/0 interface implementations.

Implementations of the VISA specification are not yet available but members of the Alliance have settled on an interim standard known as the VISA Transition Library (VTL). The VTL standard provides backward compatibility in software I/O interfaces and is available in the market now. VTL resides on the system computer and interface to the VXIbus back plane. VTL is provided by instrument controller or slot 0 interface vendors. Instrument vendors supply drivers and soft front panels that work with the VTL layer of software. Users will generally find VTL and VISA transparent to their work as it is strictly the message delivery system in the software architecture. Users should only be concerned with integrating driver functions into their application programs. The compatibility between the instrument drivers and VTL/VISA assures the user that involvement at this level of the software architecture is minimal.

The VXI*plug&play* standards that users will need to be familiar with are those dealing with instrument drivers, soft front panels and fixturing. Some discussion of the software I/0 interface layer was included to give context to system level interoperability issues solved by the VXI*plug&play* Systems Alliance. In addition to the redefinition of VXI instrument modules, the standards have also opened up exciting new opportunities and possibilities in system integration for both vendors and users. ❐

The author is with Teltronix in the USA. This article was adapted from TEKnology 5, *an in-house magazine published by Tektronix.*

The power of two – for faster, more accurate response

Now there's two good reasons to pick Yokogawa for power measurement.

Our new WT110/WT130 single and 3-phase Digital Power Meters are compact, low-cost instruments, yet both offer a high level of functionality and performance. Integrated power and current are displayed continuously. High resolution measurements can be carried out over short periods.

Both instruments can interface with GPIB and RS-232C, and operate at DC, or over an AC bandwidth of 10Hz to 50kHz, with a basic accuracy of +/-0.25%.

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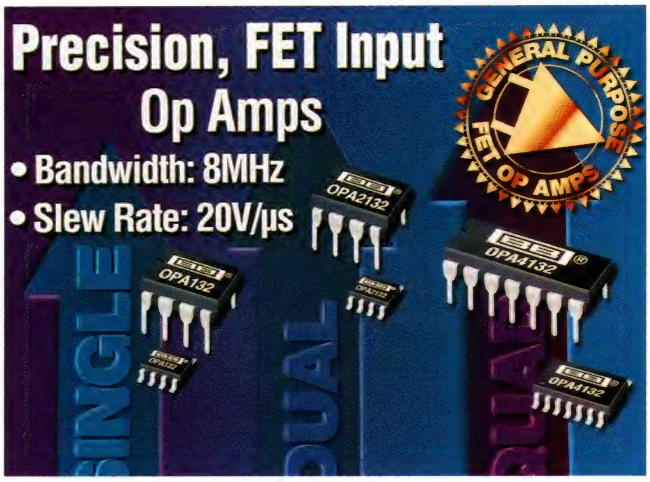
FET-input op amps



Burr-Brown's OPA132 series FET-input op amps feature 8MHz GBW and good dc performance. Available from Kenelec, the single (OPA132), dual (OPA2132) and quad (OPA4132) versions have identical specifications for design flexibility, with high performance grades available in the single and dual versions. The OPA132 series is for general purpose work like audio, data acquisition, and communications applications, where high source impedance is encountered.

OPA132 series op amps are free from phase inversion and overload problems often found in common FET-input op amps. Input cascode circuitry provides excellent common-mode rejection and maintains low-input bias current over the wide-input voltage range. The series is unity-gain stable and provides dynamic behaviour over a range of load conditions. OPA2132 (dual) and OPA4132 (quad) versions feature independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven.

OPA132 series key specification include 500µV max offset voltage, high 130dB open loop gain, 50pA max input bias current, wide ±2.5V to ±18V supply range, and an 8nV/√Hz at 1kHz low noise. Bandwidth is 8MHz and slew rate is 20V/µs. Distortion is only 0.00008% at 1kHz. [841](4)

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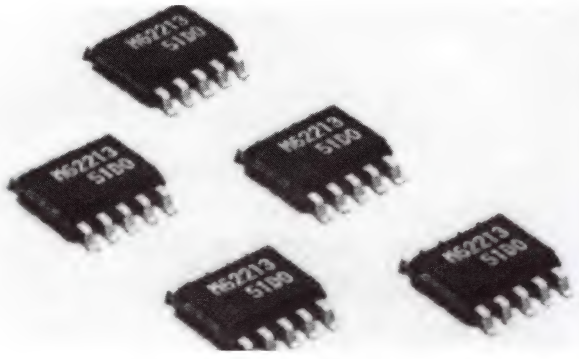
PWM controller IC



Adilam has released the M6281 pulse width modulation (PWM) control IC, enclosed in a small 10-pin package. It has as many functions as conventional types, along with a high-speed current sensing circuit.

Equipped with a high-speed PWM comparator and current limit circuit, this IC conducts switching at a speed as high as 700kHz. Despite its size, it can produce a full-scale current-mode switching power supply. [841](25)

ENTER 2417 ON CARD

PCI frame grabber

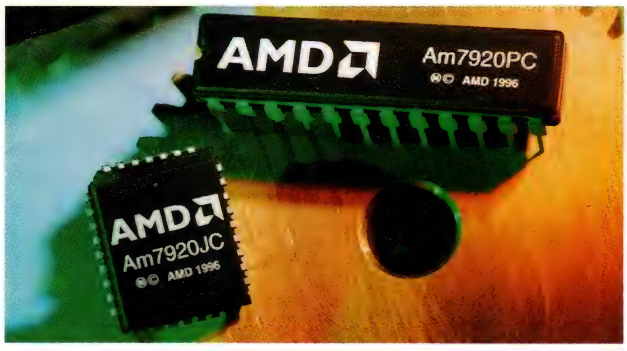
The Pulsar-LC is a PCI grabber providing analogue and digital acquisition and real-time transfers, available from the Dindima Group. Designed for imaging applications that require powerful acquisition and transfer with no display, Matrox Pulsar-LC is a lower-cost version of the Matrox Pulsar.

Matrox Pulsar-LC captures from non-standard video sources, such as high-resolution frame scan cameras at a resolution up to 1Kx1Kx8-bits at 30 frames per second or the equivalent. The board digitises 8 or 10-bit data at up to 45MHz. For digital acquisition, it comes standard with 16-bit TTL interface; an optional module is available for up to 16-bit RS-422 data. The frame grabber also features programmable gain, offset, references, synchronisation and control, as well as an external hardware trigger and exposure control. The Matrox Pulsar-LC is a PCI bus master for transfers of up to 60Mb/s to system RAM.

It comes with a 'C' development library for board control that supports Windows 3.1x, Windows NT, 32-bit DOS extenders and Windows 95. MIL, an extensive imaging library, is sold separately. Device-independent MIL contains highly-integrated commands for image processing, blob analysis, pattern matching, gauging and OCR (optional). Developers can build powerful imaging systems by combining Matrox Pulsar-LC and MIL running on the host. [388](63)

ENTER 2418 ON CARD

Subscriber line interface circuits



AMD, represented by Avnet VSI, has released a subscriber line interface circuit (SLIC) designed for cost-sensitive, high-performance POTS ("plain old telephone service") line interface cards.

A low-cost SLIC alternative for traditional transformer-based linecard designs, the Am7920 SLIC provides basic transformer-like features, including integrated battery feed, off/on-hook detection, on-hook transmission, on-chip ring trip, programmable constant current feed, and low standby power. It also offers a simple control interface that supports four control states: active, ringing, standby and disconnect (open circuit).

The device is designed for surface-mount applications, (compared to transformers which require through-hole insertions on the printed circuit board) lowering the cost and complexity of the manufacturing process. With its small package footprint, the device uses less board space and requires fewer external components than a transformer.

The device pairs with AMD's SLAC family of codec/filters to support battery feed, overvoltage protection, ringing, supervision, coding, hybrid and test (BORSCHT) functions. It also supports –19V to –58V battery operation for use with a variety of power supplies. Its low standby power (35mW) saves power for remote systems. Optional internal V_{ee} voltage regulation reduces power supply costs and simplifies PCB mounting. The flexible SLIC architecture includes four on-chip relay drivers and relay snubbers. [394](65)

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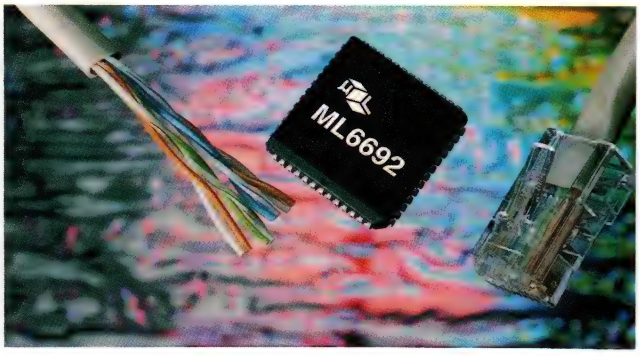
Single-chip fast Ethernet transceiver



Micro Linear through ICD has released a single-chip fast Ethernet transceiver, the ML6692, which reduces time and cost for engineers designing single-speed (100Mbps) and dual-speed (10 and 100Mbps) Fast Ethernet adaptors, repeaters and switches.

The device is a single BiCMOS chip that contains all functions needed to implement the 100BASE-TX physical layer of Fast Ethernet. The chip has a special circuit with auto-negotiation, and two intelligent circuits that do baseline wander correction and adaptive equalisation.

The architecture reduces the cost to design dual-speed networks by partitioning the low-speed, 10Mbps transceiver into the Ethernet controller where implementation is most cost effective. This approach makes it possible to design a complete Fast Ethernet adaptor that operates at both 10 and 100Mbps using only two chips.

The device also contains a multiplexer that combines its 100Mbps output with the 10Mbps output from the Ethernet controller. This allows the use of common magnetics on the output and reduces the cost of a dual-speed network.

The device's media independent interface makes it compatible with all industry-standard Ethernet controllers. For engineers who want to use older Ethernet controllers that do not have built-in 10Mbps transceivers, Micro Linear provides a single-chip transceiver, the ML2653 which contains the 10Mbps physical layer function. [841](13234)

ENTER 2420 ON CARD

Fast serial SPI memories

GEC Electronics has available the Atmel AT25XX SPI family of serial-interface EEPROMs that offer data transfer rates of 2MHz and operate from 5.5V to as low as 1.8 volts, what Atmel claims is the lowest power requirement for this class of circuits.

The devices currently available are the AT25010, AT25020 and AT25040 which are organised 128 by 8, 256 by 8 and 512 by 8 respectively. Atmel produces all four serial-interface protocols including 2, 3, 4-wire and SPI devices.

SPI devices typically utilise a 4-wire interface and were designed to meet the requirements of the bus configuration used for various members of the Motorola 6800 family, one of the fastest growing 8-bit microcontroller groups. The SPI interface used for this class of microcontrollers is faster and requires less software overhead than other protocols of serial-interface EEPROMS.

Device programming is self-timed with a maximum cycle time of 10ms. No separate erase cycle is required before the start of a write cycle. [841](13121)

ENTER 2421 ON CARD

Serial Flash devices

National Semiconductor has announced a new family of serial Flash devices, available from Avnet VSI. The devices are a low-cost solution for low-bandwidth and data storage applications, such as digital voice recording. The new 4Mbit (NM29A040) and 8Mbit (NM29A080) devices combine NAND Flash technology with National's industry Microwire interface.

The application-specific Flash memory replaces battery-backed DRAM in data storage applications. A number of data-logging applications such as medical recorders, barcode readers and industrial data acquisition systems can use serial Flash.

The Microwire interface lowers system costs and simplifies design. By using a simple 3-wire interface, fewer pins are required on the microcontroller to interface with the serial Flash. This reduces microcontroller pin count and cost. Fewer pins also means lower electromagnetic interference.

A 28-pin SOIC is used for both the 4Mb and 8Mb devices. The serial interface allows for the same board design to support both 4Mb and 8Mb densities. [841](135)

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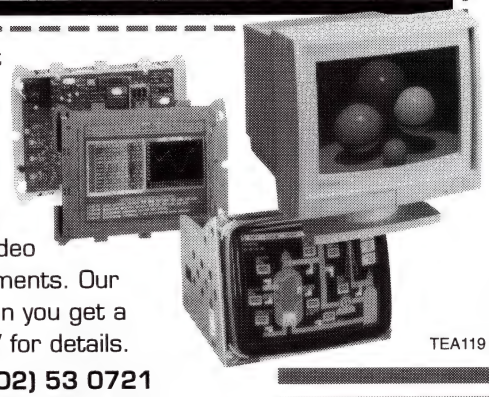

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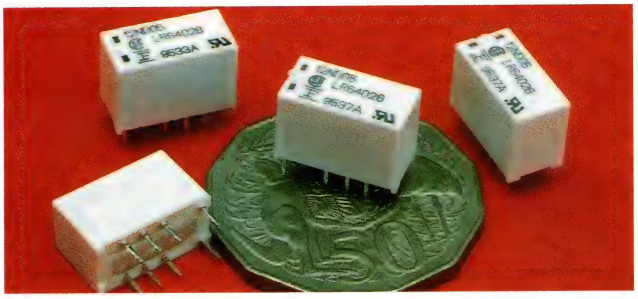
Micro relays



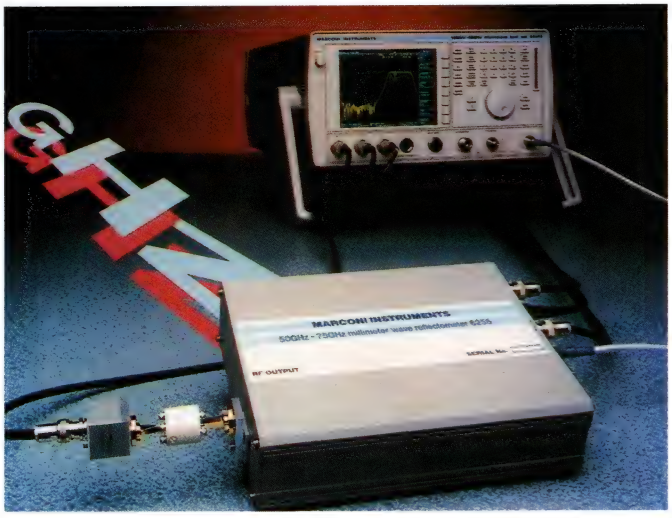
IRH Components has released the Fujitsu FBR10 series DPDT microminiature relays for telecom and signal switching applications. Measuring only 14.6x7.2x10mm, the series has dual-in-line terminal pitch.

Permanent magnet-assisted armature operation results in a coil-power dissipation of only 140mW at rated coil voltage (85mW pick up). DPDT bifurcated gold-clad contacts are rated at 2A, 30Vdc (resistive) and are suitable for low-level switching applications.

A range of coil voltages from 3 to 24Vdc is available. Stock types are 5 and 12Vdc. The devices are fully sealed for automatic soldering and immersion-cleaning safety. [2040](45)

ENTER 2423 ON CARD

Microwave test set



Marconi Instruments has available the 6250 series of millimeter wave reflectometers, offering a millimetric test system from a single source.

The 6250 series comes in two versions, each covering full waveguide bands. The 6255 multiplies the output of the 6200 to give frequencies from 50 to 75GHz (V band), while the 6256 multiplies the output of the 6200 to give frequencies between 75 and 110GHz (W band). Used with any 6200, 6203 or 6204 microwave test set, they offer a test solution to millimetric measurements.

All components and accessories required, such as detectors, couplers and voltage regulators, are incorporated in the 6250 Series, making it a convenient millimetric testing package.

In addition to the traditional range of military applications such as SMART munitions, high definition battlefield radars and covert communications, the 6250 series is suitable for a growing range of civil applications, including collision-avoidance radar equipment, inter-satellite communications, contraband detection and airborne radar. Similarly, there is a growing interest in parts of the 50 to 60GHz and the 66GHz band for point-to-point radio links. [1270](5396)

ENTER 2424 ON CARD

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PAGE	ADVERTISED	ENQUIRY CODE
9	Adilam Electronics	7403
51	Advanced Component Distributors	7431
49	Advanced Systems	7427
21	AIC	7411
34	AJ Distributors	7417
67	Alfa-Tek	7442
40	Arlec	7422
23	Avnet VSI	7412
73	Australian Photonics	7448
44	Automation & Process Control	7425
27	Braemac	7414
33	Ceanet	7416
69	Comlabs	7444
73	Comtest	7449
75	Crusader Electronics	7451
12	EMC Technologies	7405
64	Entech	7438
49	ES Rubin	7429
77	GEC	7452
1, 15	Hewlett Packard	7402, 7407
31	Honeywell	7419
67	H-P Recruitment	7441
80	IMP Engineering	7454
42	Intelligent Systems	7423
35	Interworld Electronics	7418
73	LE Boughen	7450
63	Logic 4	7437
65	M Rutty	7439
37, 57	Marconi	7420, 7434
69	MPM Components	7445
43, 69, 71	National Instruments	7424, 7443, 7446
16	Premier Batteries	7408
45	Priority Electronics	7426
17	Protel Technology	7409
25	R&D Electronics	7413
71	RFI Industries	7447
53	Rohde & Schwarz	7432
28	Siemens	7415
4	Scientific Devices	7401
79	Statronics	7453
50	Tech Rentals	7430
10	Teknor Microsystems	7404
55	Tektronix	7433
2, 67	Tenrod	7400, 7440
61	Thomas	7436
49	Unitronics	7428
11	Veltek	7455
19	Vishay	7410
13	VME Systems	7406
59	Yokogowa	7435
39	Zatek	7421

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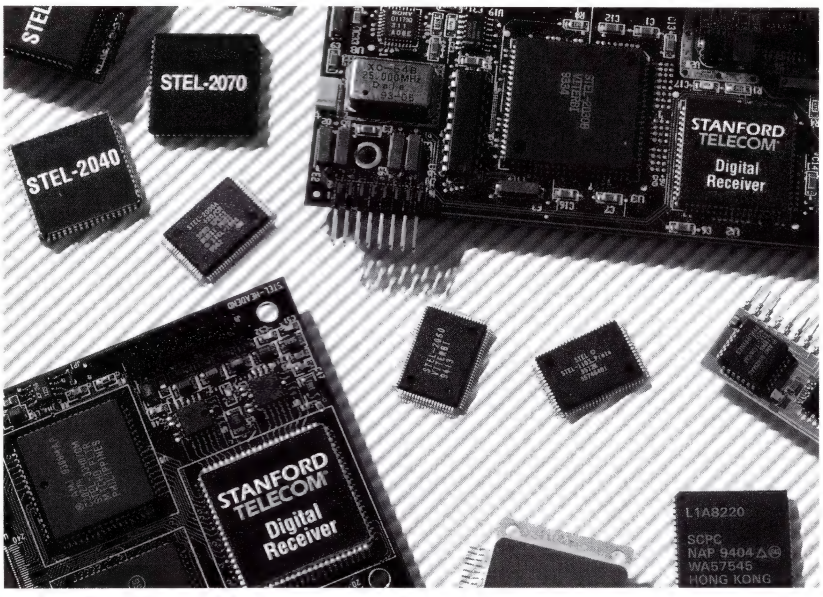


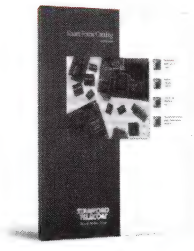
Monolithic NCOs

Product	Clock Frequency	Description
STEL-1103	100 MHz	Digital BPSK/QPSK Modulator*
STEL-1130	60 MHz	Linear Quadrature Amplitude Modulator
STEL-1172B	50 MHz	32-bit NCO, Quadrature Outputs
STEL-1173	50 MHz	48-bit NCO, Sub-MicroHz Resolution
STEL-1173RH	40 MHz	Rad Hard NCO with 1 MRad Tolerance
STEL-1174	50 MHz	16-bit NCO, Low Price
STEL-1175	80 MHz	32-bit NCO with Linear PM
STEL-1176	80 MHz	8-3/4 Decade Decimal NCO with BCD Control
STEL-1177	60 MHz	32-bit NCO with Linear PM and FM Ports
STEL-1178A	80 MHz	Dual 32-bit NCO with PSK Modulation
STEL-1179	25 MHz	24-bit NCO, PSK and Low Price
STEL-1180	60 MHz	32-bit Chirp Generating NCO
STEL-2173	800 MHz	GaAs NCO with PSK Modulation

Board Level DDS Products

Product	Output Frequency	Description
STEL-1203	0 to 40 MHz	Digital BPSK/QPSK Modulator*
STEL-1273	0 to 22 MHz	DDS with Sub-MicroHz Resolution
STEL-1275	0 to 35 MHz	DDS with Linear PM
STEL-1276	0 to 35 MHz	DDS with 0.1 Hz Resolution and BCD Control
STEL-1277	0 to 35 MHz	DDS with Linear PM and FM
STEL-1375A	0 to 35 MHz	Miniature DDS Module with Linear PM
STEL-1376	0 to 35 MHz	Miniature DDS Module with BCD Control
STEL-1377	0 to 35 MHz	Miniature DDS Module with Linear PM and FM
STEL-1378A	0 to 35 MHz	Miniature Dual DDS Module with PSK Modulation
STEL-1479	0 to 12 MHz	DDS, 1.5" by 0.8", Low Price
STEL-2273A	0 to 320 MHz	DDS with PSK modulation
STEL-2373	0 to 320 MHz	DDS Hybrid with PSK, 2" by 1.1"
STEL-9275	0 to 320 MHz	Complete DDS Assembly with Internal Clock

* New Products



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1.0A rectifiers in SMA case

Logic 4 has available from Central Semiconductor a range of 1.0 amp rectifiers in surface mount SMA cases. Four series are available: the CMR1-02M series of general purpose rectifiers at 200-1000V, the CMSH1-20M series of Schottky rectifiers at 20-60V, the CMR1F-02M series of fast recovery rectifiers at 200-1000V, and the CMR1UF-01M series of ultra-fast recovery rectifiers, at 100-1000V.

The series are designed to allow for a large reduction in board area and weight. The SMA case requires 30% less board area, and weighs less than other types of case, benefits which can be critical in small consumer electronic products. Another benefit is the SMA's flat package design which makes board assembly easier compared with the cylindrical MELF case. [799](11037)

ENTER 2425 ON CARD

Single chip vocoder

Veltek has released a single-chip vocoder from Qualcomm that utilises PureVoice, the latest version of the company's proprietary 13Kbit Code Excited Linear Predictive speech coding algorithm, named for its near-landline voice quality.

As a single-chip solution, the Q4413 vocoder can be used for a wide range of voice compression applications, including voice mail, land-mobile radios, satellite communications, secure communications and high-compression digital recording. The device supports full-duplex operation in both fixed and variable-rate modes. In fixed-rate mode, the vocoder can operate at data rates of 13.3Kbits/second. In variable-rate mode, it continuously chooses from among four coding rates on a frame-by-frame basis to ensure the best voice quality at the lowest data rate. Speech pauses are encoded at 1000bits/second, while voice is encoded at 13.3, 6.2 or 2.7Kbits/second.

The vocoder detects when the background noise level changes and dynamically adjusts its test parameters to maintain data rate and voice quality. The user can also customise the way variable rates are chosen to meet the data rate requirements of a particular application. For telecommunications applications, an optical G.165 network echo canceller and dual-tone, multi-frequency support are included on the chip. [841](3946)

ENTER 2426 ON CARD

Keylock and rotary control switches

The Burgess TOK range of keylock and rotary control switches, available from Email Electronics, comprises the E, M, P2, K2 AND P5 series. Modular in concept, their positive indexing contributes to switching quality and numerous switching functions are achieved by a variety of cam profiles.

Security is a feature of the TOK range, with several lock types available ranging from general purpose to very high levels of security.

Switches in the range can be used in applications as diverse as access control, military electronics and control, electronic point of sale equipment, process control, security in the automotive industry, domestic and commercial premises, mechanical handling and lifts and escalators.

The E and M series are low cost, low current and compact in size. They are classed as anti-tamper to medium security applications and high volume users may be allocated a "unique key" for exclusive use. Static resistance is available from 7kV to 30kV.

The P2 and K2 series for up to 250 Vac have a die-cast body and range in application from general purpose to very high security using either disc tumbler or radial pin tumbler blocks. As an alternative to a key, these switches are available with either spindle or integral knob. Unique key numbers can be made available on request for high security requirements.

The P5 series has the advantages of the P2 and K2 with the added benefit of higher voltage and current and a choice of switching functions and actuators. [810](100)

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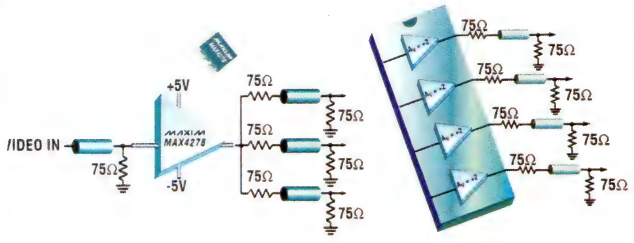
Precision buffers



Video Distribution Amp Gain +2, Cable Driver

Veltek has available from Maxim Integrated Products the MAX4178/MAX4278 and MAX496/MAX497, a new family of high-frequency, single and quad closed-loop buffers with fixed gains of +1 (0dB) or +2 (6dB). These devices are for use in component or composite video, medical imaging, RF, and telecom applications.

A patent-pending two-stage architecture provides the high bandwidth and slew rate of current-mode feedback designs and the low noise and offset precision of voltage feedback designs. Unlike existing high-frequency buffers, ac parameters are guaranteed. The unique design also supplies a superior output stage that delivers a 70mA minimum output current, an output swing greater than ±2.5V over temperature into 50Ω, and the ability to drive capacitive loads in excess of 70pF without oscillations.

The MAX4178 and MAX496 are single and quad buffers with a fixed gain of +1 that provide a 375MHz -3dB bandwidth, an 80MHz 0.1dB bandwidth and a slew rate greater than 1400V/µs. The MAX4278 and MAX497 are single and quad buffers with a fixed gain of +2 that provide a 275MHz -3dB bandwidth, a 120MHz 0.1dB bandwidth and a slew rate greater than 1500V/µs. A fixed gain of +2 eliminates the need for external feedback resistors when driving back-terminated 50Ω or 75Ω coaxial cables.

Other key parameters include a supply current of only 8mA per channel and an ultra-low differential phase/gain of 0.01°/0.01%, respectively. Precision dc parameters include an input offset voltage of only 0.5mV and 5.6nV/√Hz input referred voltage noise. [841](3946)

ENTER 2428 ON CARD

64-bit processor

Integrated Device Technology has introduced the R5000 MIPS RISC microprocessor. Available from GEC Electronics, this superscalar processor provides enhanced graphics capabilities for visual computing and high bandwidth for internetworking applications.

At 200MHz, the device delivers 5.5 SPECint95 and 5.5SPECfp95 and provides performance levels comparable with processors such as the PowerPC 604e. It has enhanced floating point computing capabilities and scalable integer performance.

The two-way superscalar execution core allows dual-issue instruction capability, enabling the CPU to fetch two instructions from the cache per cycle for high-speed, low latency ALU operations with other instruction classes. The device is capable of 4GBps aggregate bandwidth utilising two-way set associative 32KB instruction and 32KB data caches.

The R5000's data movement capability and on-chip secondary cache controller make the CPU a high-performance, high-bandwidth option for internetworking systems such as ethernet switches and routers. These systems also use the R5000's large caches, optimised write protocols and high-performance integer unit. [390](13121)

ENTER 2429 ON CARD

API for I/O simulation

Alfa-Tek has available Software Development Systems' SingleStep peripheral application programming interface (API), which provides an approach to simulation that offers complete and accurate modelling of integrated peripherals in embedded designs. This API, when coupled with the SDS SingleStep integrated debugging environment, offers the embedded software developer a more productive environment, including: 100% software validation of target embedded processor and peripherals; simulation of MPC8XX microprocessor functionality; and availability of standard peripheral models for Timer and UART.

An additional benefit of the toolset is that it enables the test and validation of device driver code before committing to hardware integration.

SingleStep is an intuitive graphical development environment for embedded, real-time applications. It gives developers the ability to edit, compile, link, download and debug their applications without leaving the SingleStep environment. SingleStep's graphical interface translates well into all versions of MicroSoft Windows and into UNIX and Motif. It offers integration of embedded C and C++ compilers offered by SDS and supports the ELF/DWARF and PowerPC EABI standards allowing engineers to select other PowerPC compilers, if preferred. This point-and-click integration support includes compilers from Diab Data, GNU, Meta Ware and Motorola. SingleStep also provides true kernel awareness for many real-time operating systems including VxWorks, pSOS, RTXC and Nucleus. [384](696)

ENTER 2430 ON CARD

RF current immunity tester

The Schnaffner NSG420 RF current immunity tester, distributed by Westinghouse Industrial Products, provides an alternative to electromagnetic immunity testing to IEC 1000-4-3/801-3 as well as pre-compliance testing for IEC 1000-4-6/801-6, and can be used for development, test and production applications.

A wide-band RF frequency source provides a 'comb' spectrum signal which is injected in one of the conductors of the device-under-test (DUT), by means of a clamp-on current transformer. The instrument signal can be AM or FM-modulated with synchronisation of other test equipment or, under external command, can provide spot or sweep-modulated frequencies.

Below 300MHz, current injection testing provides the kind of reproducibility normally achieved with radiation testing where conductor position can be critical.

The device is palm-sized, battery-operated, has an integral two-part transverse-slot current transformer to accommodate cable to the DUT, an LED bar display indicating RF power in dBA, internal 1kHz modulation oscillator, modulation connector for synchronisation, output level control and dc-level remote-monitor output. [1270](2815)

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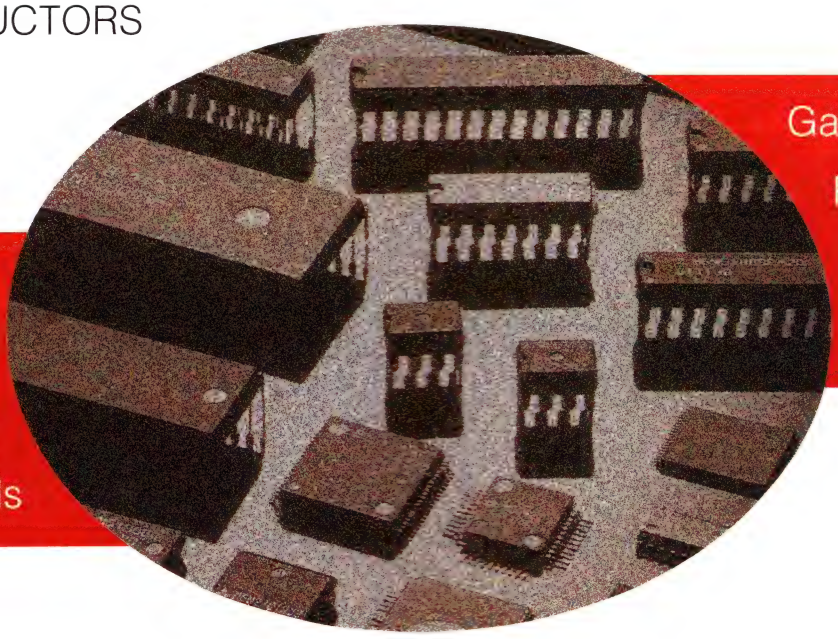

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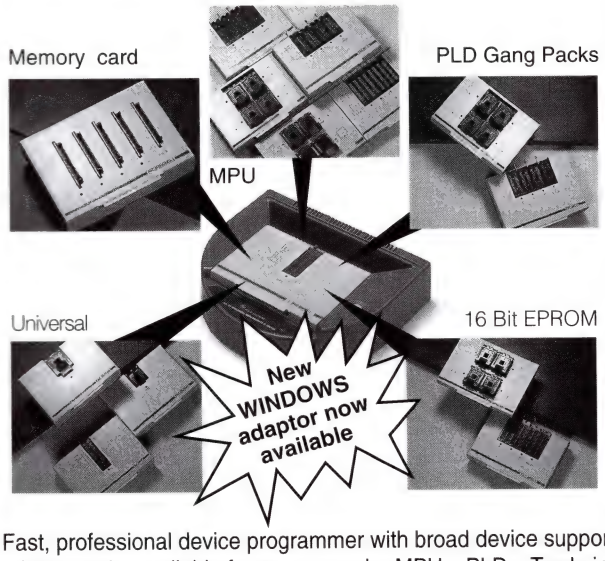

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ENTER 7442 ON CARD

Pentium processor upgrades

Intel Australia has released its Pentium OverDrive processors for upgradable Pentium processor-based systems. Based on the same .35 micron silicon technology used for Intel's fastest Pentium processors, the design of the Pentium OverDrive processors includes enhancements beyond the original core microprocessor.

The products being introduced include the 120/133MHz Pentium OverDrive processor, designed to upgrade 60MHz processors to 120MHz and 66MHz Pentium processors to 133MHz; and the 125MHz Pentium OverDrive processor designed to upgrade 75MHz processors; the 150MHz Pentium OverDrive processor, designed to upgrade 90MHz processors, and the 166MHz Pentium OverDrive processor, to upgrade 100MHz model processors.

Intel has added features to the Pentium processor technology core to support the system configurations present in the installed base of systems. These include added capacitors to provide the required voltage filtering needed when putting a faster Pentium processor in a system originally designed for a slower processor.

The upgrade comes with a fully-integrated on-package fan that ensures the processor is properly cooled. The preconfigured core-to-bus speed ratios mean end-users need not worry about locating and setting jumpers.

The 120/133MHz Pentium OverDrive processor also includes a voltage regulator and compatible pin-out for upgrading the 5V 60 and 66MHz Pentium processors to a 3.3V Pentium OverDrive processor. The OverDrive comes with an installation manual and a diagnostics disk. [390](375)

ENTER 2432 ON CARD

Brushless DC micromotors

The two-wire brushless dc micromotor from Erni Australia, with its integrated drive electronics, combines the advantage of the ironless rotor with skew wound coil technology and electronic commutation.

The type 1935 S...BRE motor measures only 19mm in diameter by 35mm length and has a solid 3mm output shaft. The design features linear characteristics and absence of cogging torque, and the sensorless integrated electronic drive circuit allows for two-wire dc voltage operation, meaning no dangerous commutation sparks.

Offered in three standard windings, the motors operate between 4 and 16Vdc at continuous speeds up to 10,000rpm with a starting torque of 4.4mNm. The lifetime of the devices is limited only by the preloaded ball bearings.

This series of dc micromotors was developed in response to market requests for a small, cost-effective brushless motors in applications for continuous duty operation, such as small pumps, fans, choppers and scanners, in both industrial and medical instruments. [804](117)

ENTER 2434 ON CARD

New SPICE models

Zetex has launched Version 2 of its SPICE models diskette, available from GEC Electronics. It features high performance discrete transistors and includes 281 different models drawn from 108 parent chips. Models can be represented as text files or generic symbols enabling faster schematic simulation and test.

The V2 SPICE models diskette can accommodate the 281 models either as separate .MOD files or within a new symbols library structure. The symbols library allows P-SPICE for Windows to access the models within a schematic drawing.

Device models featured on the diskette include the Zetex SuperSOT range of high current, low $V_{CE(Sat)}$ devices of much interest in portable battery powered system design, small signal bipolar transistors for general purpose application, as well as the Zetex range of MOSFETs, diodes and RF and switching transistors.

Included on the V2 SPICE diskette are text files, providing users with information and advice on model use and relevant spice parameters and a clear description of the installation procedures and usage options. [384](13121)

ENTER 2433 ON CARD

Advanced HCMOS family

A new HCMOS logic family from Texas Instruments, available from ACD, is for designers of high-performance systems wishing to increase performance without increasing cost.

The new Advanced HCMOS (AHC) devices are three times faster than HCMOS logic, while remaining pin-to-pin compatible. They are suitable for telecommunications equipment, portable and desktop PCs, networking hubs and routers. Because of their low noise and reduced power consumption, they are suitable for portable, battery-operated systems such as laptop and notebook computers, personal digital assistants and handheld scanners.

A typical propagation delay for an AHC device is just 5.2ns while the maximum propagation delay for any device in the family is only 8.5ns. Both AHC and HCMOS exhibit very low levels of electrical noise and both types of logic have the same electrical drive characteristics. With a 5V power supply, AHC logic has an output current of 8mA.

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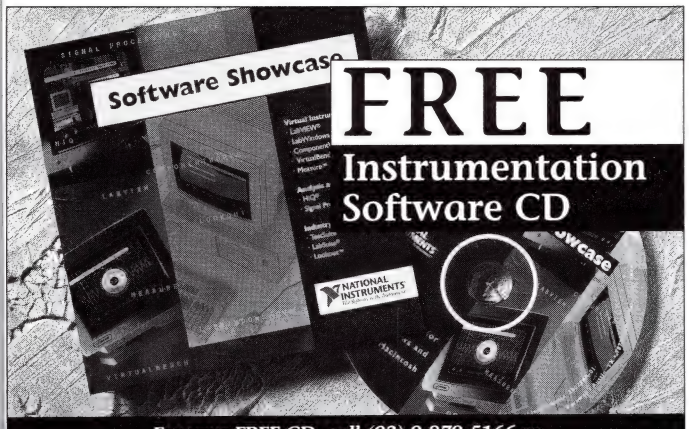

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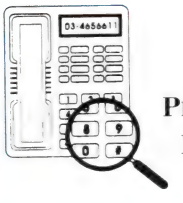

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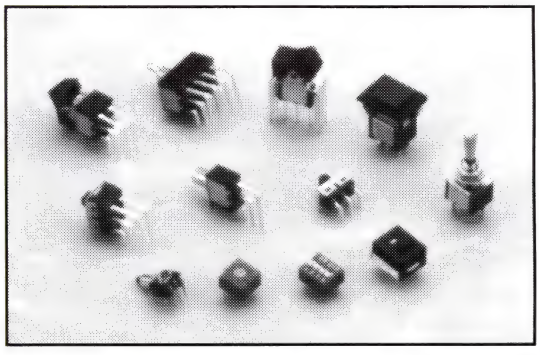

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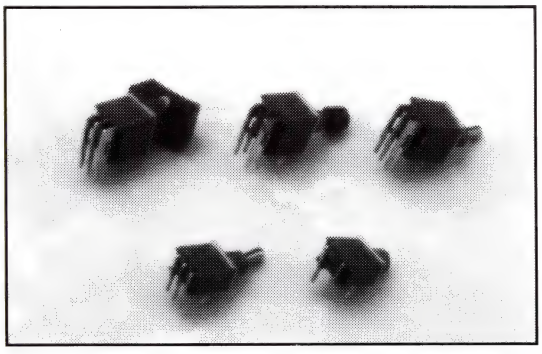

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The LabVIEW demo features a tutorial-style manual and a menu-based system so users can view the applications and information available through all palettes. Information about the Alliance program, customer educations and technical support and toolkits are also available.

The LabVIEW brochure contains information about the Version 3.1.1 LabVIEW and explains how it can be applied to test and measurement, process monitoring and control. It illustrates examples of real-world applications, add-on tool kits and other user-productivity tools available as well as resources like technical support, instrument library development program and an Internet forum for LabVIEW users. [2430](9180)

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Industrial PC catalogue

Acrosser Technology has available volume 54 of its Industrial PC shortform catalogue. It details the range of industrial CPU cards, I/O cards and PC chassis, enclosures and panel PC's and is available on request from Backplane Systems Technology Pty Ltd. [2430](5905)

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Radiotron designers handbook on CD-ROM

F Langford-Smith's seminal 1952 tome on valve/tube radio receivers and amplifiers, *Radiotron Designers Handbook* has been released on CD-ROM, available from ME Technologies. At 1500 pages in book form, this disc should be an essential item for enthusiasts of those glowing vacuum tubes.

The contents have been annotated chapter by chapter with links to all major subheadings within any given chapter, allowing (with the use of the attached software) readers to jump directly to a topic from the table of contents and then scroll through the appropriate pages.

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The disc comes with Adobe Acrobat software for hyperlink access to the book via the contents and index. You will need an IBM 386 or compatible with Windows 3.1 or above. [2430](11128)

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Metering catalogue

NHP has two free catalogues available, one covering metering products, the other covering static energy meters.

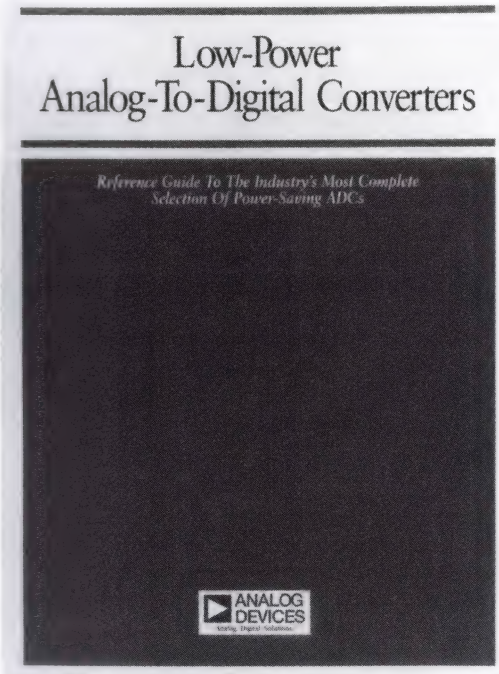
The 16 page 'ITC' catalague covers analogue, digital, rail Din meters, measurement current transformers and transducers. It comes with dimensional drawings, illustrations and overviews of product ranges and should prove handy to those involved in the selection of electrical instrumentation systems.

The VEM Veko catalogue of IME KWH meters covers the metering of efficient energy usage and methods for monitoring the status of plant equipment and comes with technical information and diagrams. [2430](152) **ENTER 2439 ON CARD**

Power saving ADC brochure

Analog Devices, represented in Australia by Hartec, has released an eight page brochure, *Low Power Analog-to-Digital Converters*. Illustrated with diagrams and selections charts, this booklet will benefit designers looking for an ADC to suit their power and performance needs.

The guide looks at the AD785x 12-bit ADC range, the AD7880 and 7883 medium speed 12-bit sampling ADC's with voltage options. Information is also included on a controller board and device for evaluating the performance of the ADCs, along with a reference for technical assistance and sample information. [2430](7327)



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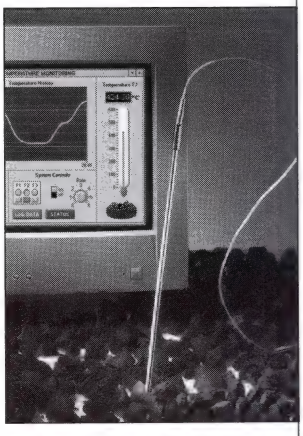

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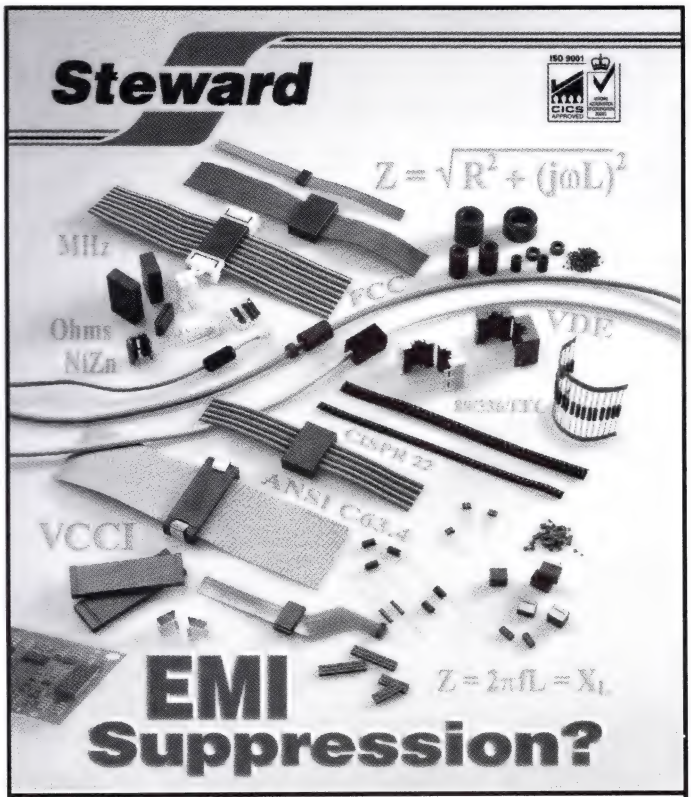

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DESIGN TIP # 34

Filters

Single amplifiers give multi-stage headaches

Filters for audio frequencies can be quickly developed using op-amps in a variety of ways. However, using the same techniques at frequencies above 10kHz can bring into play limitations not readily apparent at lower frequencies. *Rex Niven* explains.

A colleague of mine once grumbled that he could never get the filter circuits in the op-amp manufacturer's catalogue to work. Being rather naive we supposed that being a printed document from overseas, the catalogue was almost certainly right. A browse through a semiconductor manufacturer's bible or op-amp "cookbook" suggests that a single amplifier plus a few resistors and capacitors gives a two or three-pole filter of quality. Later when I worked on an analogue integrated circuit, I found the filters were all realised using a three-amplifier topology, which seemed at the time to be inefficient. However, a closer look at the single-amplifier solutions reveals some serious shortcomings.

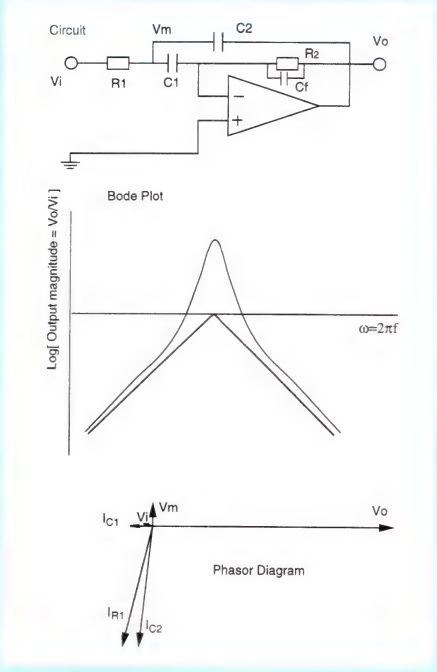

Figure 1. Single amplifier band-pass filter.

The circuit shown in *Figure 1* is a bandpass filter with a very low parts count. A bandpass filter is usually required to be selective and amplify only a narrow range of frequencies, i.e. to have a Q rather greater than 1. However to achieve a moderate value of 5, R2 must be much higher than R1 (for Q=5, R2≈100R1). The capacitance values C1 and C2 should be equal for maximum Q. The values of voltage and current in the circuit are evaluated by assuming a certain output voltage, then calculating the voltages and currents until the input is determined. This is shown graphically in the phasor diagram shown in *Figure 2*. The phasor diagram for the *Figure 1* circuit reveals that the amplifier must have a gain of at least 50 with minimal phase error. This means that the effect of a very small capacitance between the input and output of the amplifier has a dramatic effect, as outlined below.

$$\frac{-sR_1C_2}{(s^2R_1R_2C_1C_2+sR_2C_T+1)}, \text{ where } C_T=C_1+C_2 \text{ and } s=j2\pi f$$

It would be reasonable to imagine that the input impedance of the filter is equal to about R1. However, some analysis shows that this not the case. In the example in *Figure 1*, the intermediate voltage Vm is large and at a large phase angle to Vo. The input current, surprisingly, is many times Vi/R1. When driven from another op-amp the amplifier output impedance may cause a considerable loading. In the above example, the magnitude of the input impedance is approximately R1/10.

In practical filter realisations, there is a finite capacitance between the op-amp output and its input. This is due partly to the circuit package and also the circuit board tracks. For quad op-amps in a DIL package, the pins are actually adjacent, almost guaranteeing at least 1pF of capacitive coupling without special precautions. The high gain in the circuit increases the effect and significantly changes the Q and centre frequency. The addition of C_F changes the transfer function as follows:

$$\frac{-sR_1C_2}{(s^2R_1R_2(C_1C_2+C_FC_T)+s(R_1C_T+R_2C_F)+1)} = \text{Vout / Vin}$$

where $C_T = C_1 + C_2$ and $s = j2\pi f$

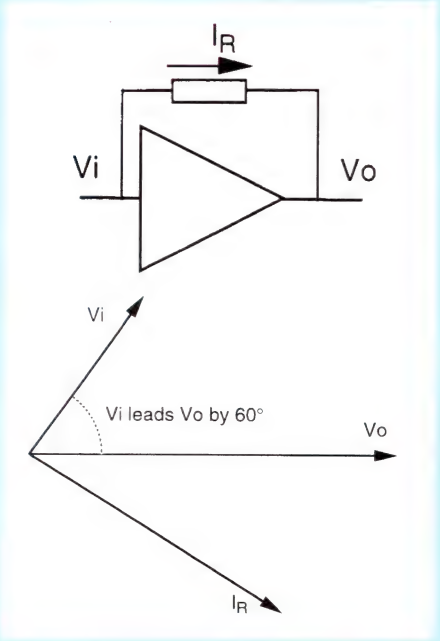

Figure 2. Voltage and current phasor diagram for an op-amp.

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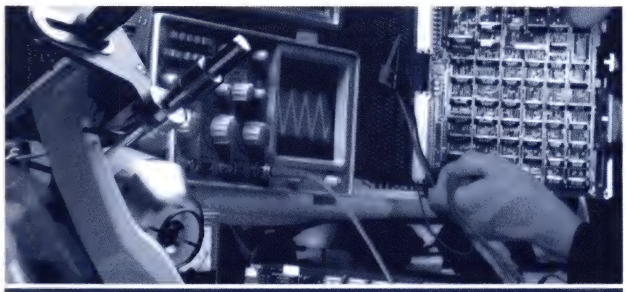

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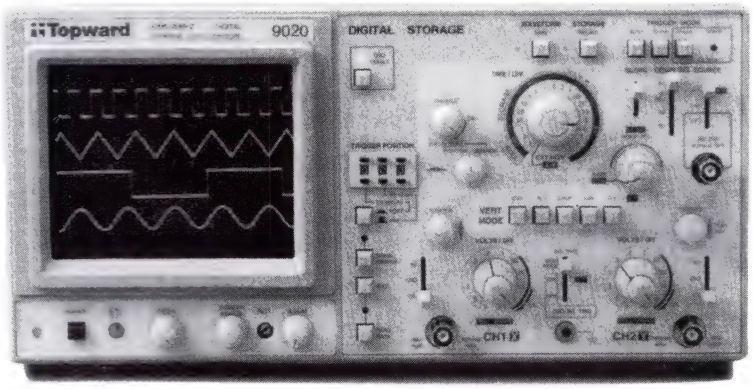

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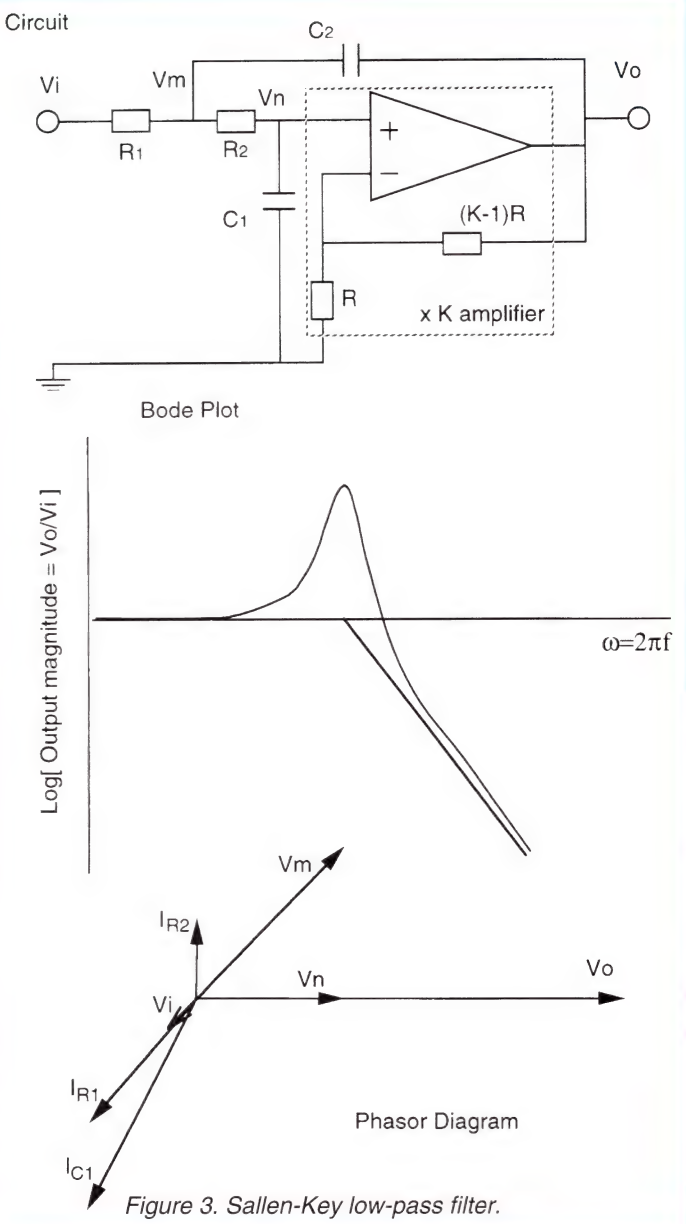


Figure 3. Sallen-Key low-pass filter.

In this example, R2 = 100R1, so C_F has an influence 100 times its "apparent" value.

Gain-bandwidth product of the amplifier can also be a limit where high frequencies and high gains are required. Even where the op-amp gain is still higher than the gain with feedback, there can be a significant phase shift which reduces performance at high values of Q.

The Sallen-Key low-pass filter (*Figure 3*) has some advantages in that the resistors and capacitors are of equal value, and high Q is achieved for moderate amplifier coefficient K of near 3. However, the Q is very sensitive to small changes in the value of K, and for Q values greater than 1 the input impedance is again less than R1. In this case the transfer function is :

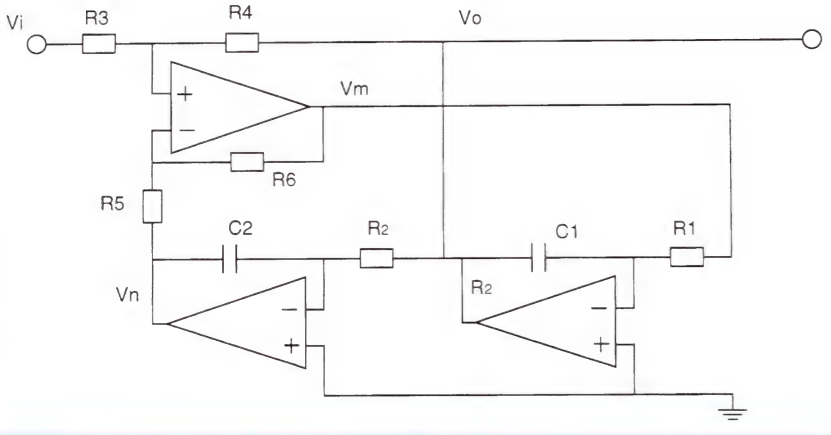
$$\frac{+K}{(s^2R1C1R2C2+s(R1C1(1-K)+(R1+R2)C2)+1)}=Vout/Vin$$

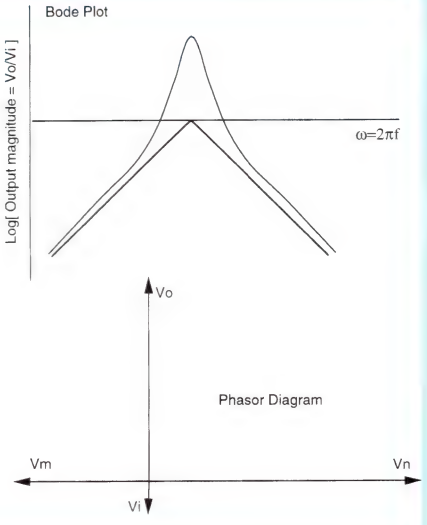
The reason for the variation in input impedance can be understood as follows. For a fixed output the input current required (I_{R1}) is calculated as shown in the phasor diagrams (*Figures 1 & 3*), and is relatively constant with frequency. In both the above filters the voltage Vm at the junction of R1 and C1 is of nearly opposite phase to Vi, and somewhat larger. At resonance, the input Vi drops but the input current does not. The input voltage Vi drops more as the Q and gain rise. For a different frequency, the magnitude of the input Vi required for the same output is much greater, which is the same as saying the Q is high. Therefore the input impedance at resonance (=input voltage/input current) also drops as the Q rises.

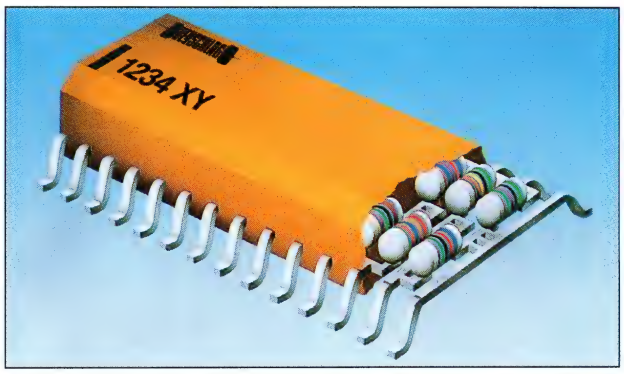
The three-amplifier state-variable filter (*Figure 4*) operates similarly with few drawbacks other than component count. At the resonant frequency the signal at Vn gives a current through R5 which exactly balances that through R6 from Vm. At that point the input needed is only that to balance the damping current flowing from Vo via R4. This filter is easy to design since the resonant frequency, overall gain and Q can be set independently. Even so the input current is approximately constant in the resonant region, suggesting that the input impedance is frequency dependent, but with a value at resonance of R3. ❐

Rex Niven is manager of the Australian Photonics Cooperative Research Centre's Optoelectronic Product Development Facility, located in the Photonics Research Laboratory at the University of Melbourne.

Figure 4. State-variable band-pass/low-pass filter.







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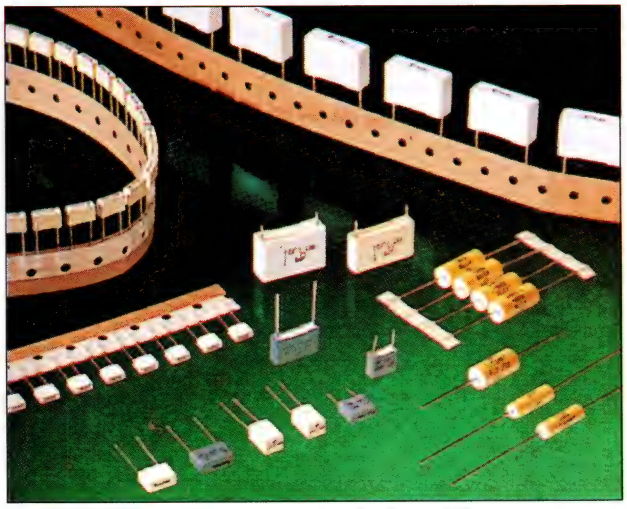

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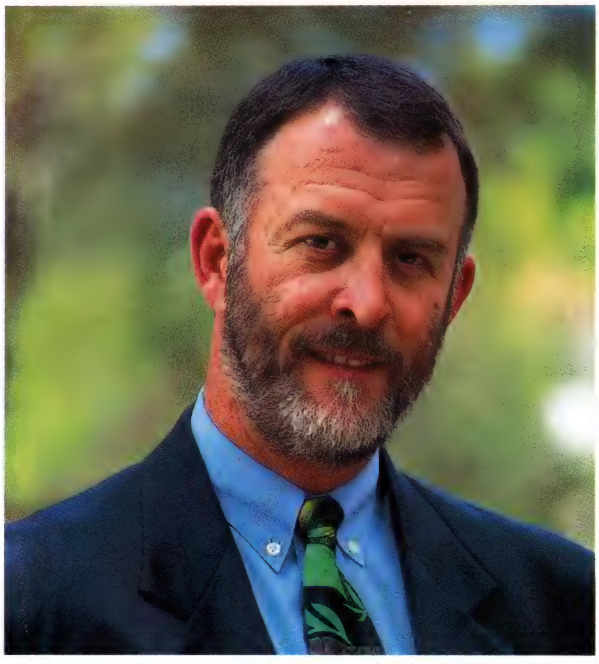
Greg Boundy

Manufacturing a future

After fire destroyed PCB maker IMP Engineering's Adelaide factory two year's ago, General Manager Greg Boundy set about the task of dusting off the ashes and refocusing the company.

By Rob Irwin

Greg Boundy is a South Australian man through and through. He was born in Adelaide in 1955 and studied economics at picturesque Adelaide University. He finished his degree in 1976, which he did on a cadetship basis with accounting firm Price Waterhouse. Greg went on to get his chartered accounting qualifications and worked with Price Waterhouse in the auditing, consulting and taxation areas. The accounting work gave Greg an insight into a number of industries. "It gave me a chance to see a very diverse range of industries and businesses, from very small backyard operations through to multinationals," said Greg. "It was during that phase that I developed an interest for the manufacturing-type environment, where you can see where the value is added, rather than a financial environment which was very much confined to service-type industries."



Greg also wanted to work in a hands-on environment in which he was dealing with people and had the ability to develop people within an industry. "I was looking for an environment where I could move from a professional accounting environment to a hands-on manufacturing environment, and I was particularly looking for organisations that were Adelaide-based where you could have high degree of control and flexibility in the way you operated, rather than be at the dictates of an interstate or overseas organisation."

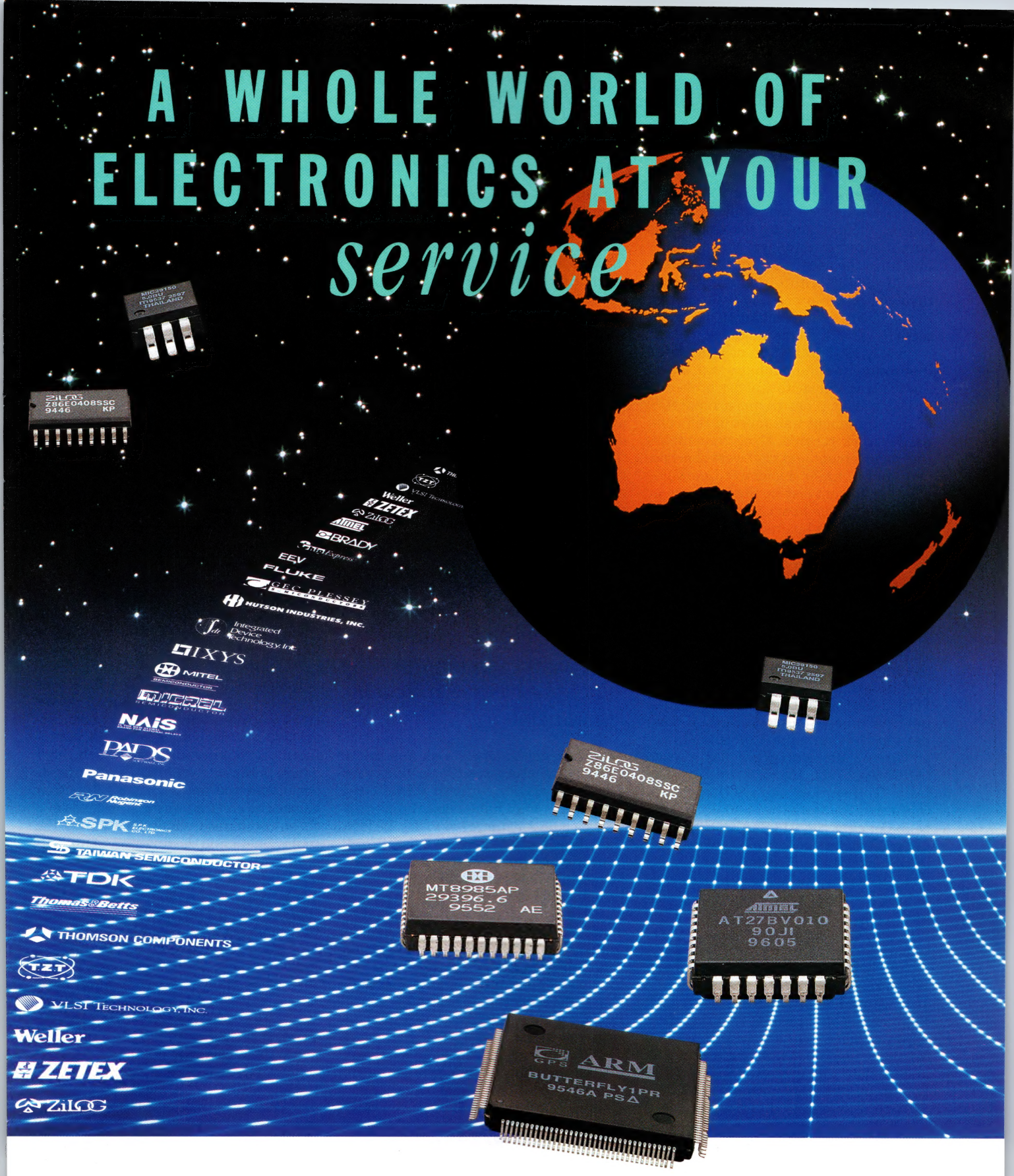
His search led him to whitegoods manufacturer Simpson. "I joined Simpson's head office and was involved in finance, but with a clear view that after a reasonable period of settling in I would move into a more functional part of the business. About two years later I took over as General Manager of the clothes dryer division. That was the first opportunity to work extensively in a manufacturing environment with a business involved in developing, manufacturing and selling products." Greg enjoyed his role immensely and felt he'd found a comfortable niche.

He was promoted to head of Simpson's range division, but after about three years the company was taken over by Email, which didn't suit Greg at all. "One of my objectives has always been to work for a locally based company, and at that stage Email was Sydney-based." Greg cast his net around and identified high-technology company Codan as the way to move. "It was an Adelaide-based company with a focus on technology, exporting and development of people in a professional environment, but it also had a family-type atmosphere."

Greg started with Codan in 1989 and was initially involved in some troubleshooting — improving the company's performance after the economic downturn of the time. Codan's core business was the design and manufacture of high-frequency radio equipment. It also had a subsidiary, IMP Engineering, which was involved in the manufacturing of printed circuit boards. "Fairly early in my career with Codan I got involved with IMP on a part-time basis and assisted in resolving some issues to help its performance. At that time it was located in premises that would create a limitation in terms of its ultimate capacity, and for the next few years we focused on growing the business within those capacity confines."

Greg took over the role of manufacturing manager for Codan, a move that put him in an unusual position. "Ironically, it involved me buying PCBs from IMP as well as being involved in IMP's management. So I was on the supply and demand side of the equation," commented Greg with some amusement.

His multiple roles, however, gave Greg a wide-ranging experience of different manufacturing environments. "Codan was very vertically integrated. Not only did it have its own PCB business, it had its own metal working facility, manufactured its own transformers for internal use, and a lot of cables and looms were made specifically for customer



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requirements.

"It even had its own internal board-loading facility. During the time I was manufacturing manager, the company identified the need to establish a surface mount facility within Codan. So I was involved in the process of establishing that facility, and the choice of equipment."

In May 1994, IMP's fortunes and Greg's involvement in the company took a dramatic turn. A devastating fire broke out at IMP's factory, destroying around 80% of the equipment and most of the company's work records. Greg remembers the management and staff were shocked. "We had a major decision to make — whether to reinvest in the business or walk away. Our hearts told us to keep investing in the business, but we knew that we needed to do an appropriate business evaluation to determine whether that was sensible, given that it would require a much higher level of investment in the business than we'd previously had."

Codan engaged external consultants to conduct a market survey to give an understanding of the direction of the PCB industry in Australia. Using this information and that contained in a similar report done by the Australian Printed Circuit Manufacturers' Association (APCMA), Codan decided to reinvest in IMP. "The market surveys that we did confirmed the work that had previously been done for the APCMA — that market growth was going to be there within the Australian PCB industry."

IMP began the process of recovery helped, according to Greg, by a loyal customer base. "There were a number of factors that enabled us to continue operations. The most important was the loyalty we had from our existing customers. We had a strong group of customers who still wanted to do business with IMP Engineering, to the extent that they were happy to place their orders with us during the period immediately after the fire, and we then subcontracted that to other PCB manufacturers within Australia."

Within the space of nine month IMP was fully operational at a new site, with virtually all of its old employees retained. Many of IMP's employees were temporarily attached to other divisions within Codan till the new IMP facility was ready. "That enabled us to ensure that we had fully trained and operational staff in place to facilitate operations on the new site."

Since reopening its doors, IMP has steadily increased its share of the market. In January 1996, Greg came on board full-time as general manager in recognition of the need to closely direct and monitor the direction set in the business plan formulated after the fire.

Codan's decision to stick by IMP has meant heavy investment by the company. But according to Greg, it's a carefully calculated investment in the future of the PCB industry in Australia. "Our studies confirmed what the APCMA studies have revealed, and that is a very strong demand for fast-turnaround prototyping within the Australian electronics manufacturing community, and a very strong need for quick turnaround in small to medium production runs."

Greg feels that this area of the market is where Australian manufacturers can excel. While the high-volume end of the business is attractive, he feels Australia lacks the advantages enjoyed by more populous nations. "We have the ongoing issue of price competitiveness with higher volume runs."

Those of us who are pitching ourselves to be high-quality, credible manufacturers do suffer when there are manufacturers in the business which don't aspire to the same standards.

One critisism levelled at Australian PCB manufacturers in the past has been a lack of quality control. While Greg agrees this may have been the perception of some consumers of PCBs, he feels the situation has improved significantly in the last few years. "I think manufacturers of PCBs generally need to maintain a very high standard of quality so that the industry is well perceived by electronics manufacturers. I believe the industry in Australia has moved that way significantly over the last five years. IMP was one of the first organisations to get ISO 9002 certification. We've had that for nearly five years now, and generally the industry as a whole has moved that way. I think the move to ISO certification has helped in establishing the industry's credibility from a quality perspective.

"As well as providing quality product, though, I think the industry also needs to improve its customer service. It needs to be providing services other than just the PCB itself — assisting in the design of the product and ensuring that delivery times are met, etc, are key ingredients in future success."

With the ravages of fire behind it, IMP is setting sights firmly on the future. Greg has firm confidence in PCB manufacturing in Australia, but recognises the need to continue adapting to a changing market. "I think we must continue to learn the lesson of listening to the customer, to all their needs, and responding to them and being very flexible. I think the answer for Australian manufacturers in the 90s is to offer flexibility in services to the customer, because at the end of the day that's what will bring the customer back for repeat orders.

"To prosper, we need to improve to the extent that manufacturers can think of a local PCB supplier as a first choice, rather than go offshore. In the past some customers have been reluctant to use Australian manufacturers because of perceptions of poor quality and varying degrees of turmoil within in the industry over the years, with players moving in and out. What we need is a stable group of PCB manufacturers providing a high quality product with excellent delivery times and outstanding customer service to establish an environment where customers can reliably go out and buy on the local market. Obviously we need to be price competitive as well, but I think the mere fact that there is a now a number of credible manufacturers within Australia ensures a bright future for the industry.

"There's still a need for some rationalisation in this business, though, because those of us who are pitching ourselves to be high-quality, credible manufacturers do suffer when there are manufacturers in the business which don't aspire to the same standards. That hurts the industry at large, and anything that focuses on strengthening standards and those companies which have made the commitment and the investment in those standards is welcome.

"I think if you look at the history of any businesses or industries in Australia, there has been a rationalisation to reduce the number of manufacturers. That hasn't occurred to the same degree in the PCB industry and I've often intrigued by why that is. In many cases individual businesses have been able to establish a customer base within a State that provides a core of activity, and has perhaps cushioned them from the impact of national competitiveness. But I see that changing.

"Who's to know what the ultimate number of PCB manufacturers will be? I think there is a core now — a group that is likely to be around for a substantial period of time. Some of those that have not invested to the same degree as the core group may not be with us further down the track."

Away from work, Greg cites his major passion as music. He is a keen pianist and has an extensive collection of music ranging from the classics through jazz to mainstream rock and pop. Greg's wife Valerie and their three children share this musical bent. "Music is a constant in my environment." ❐

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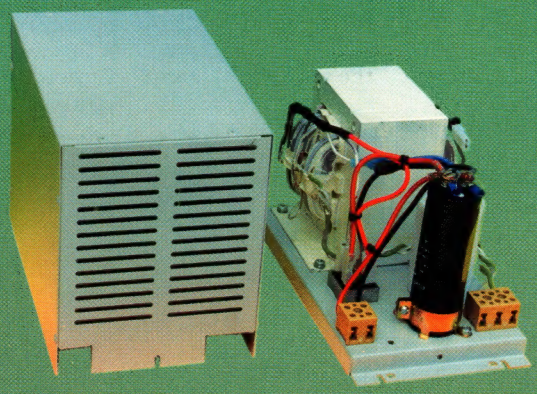

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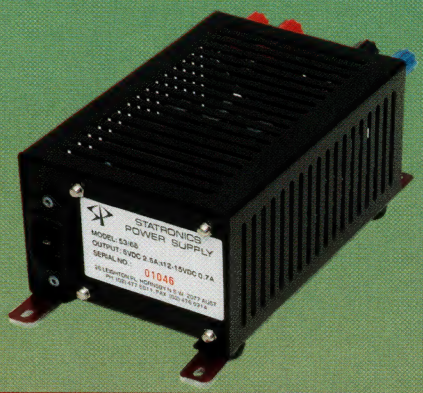

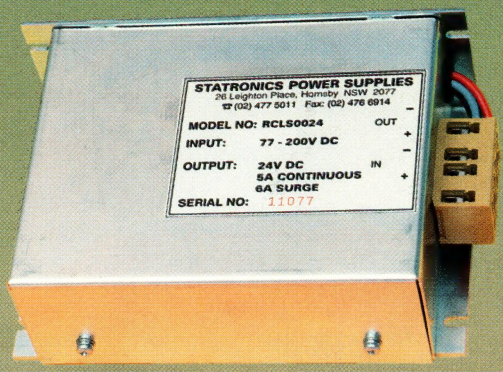

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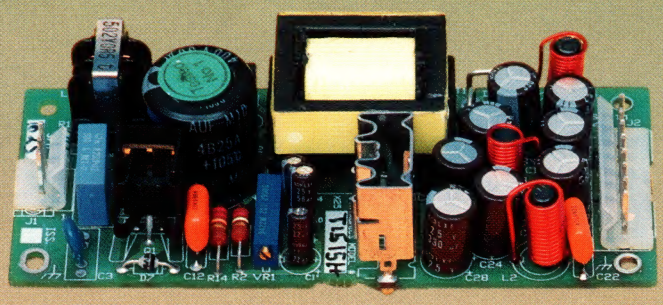

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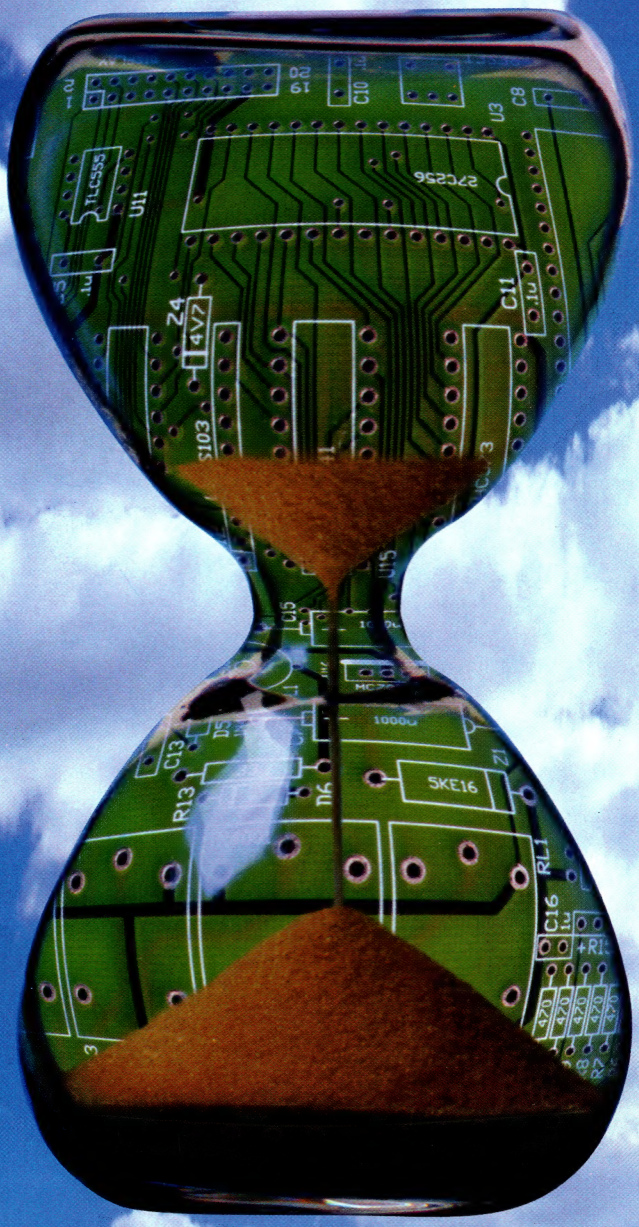

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